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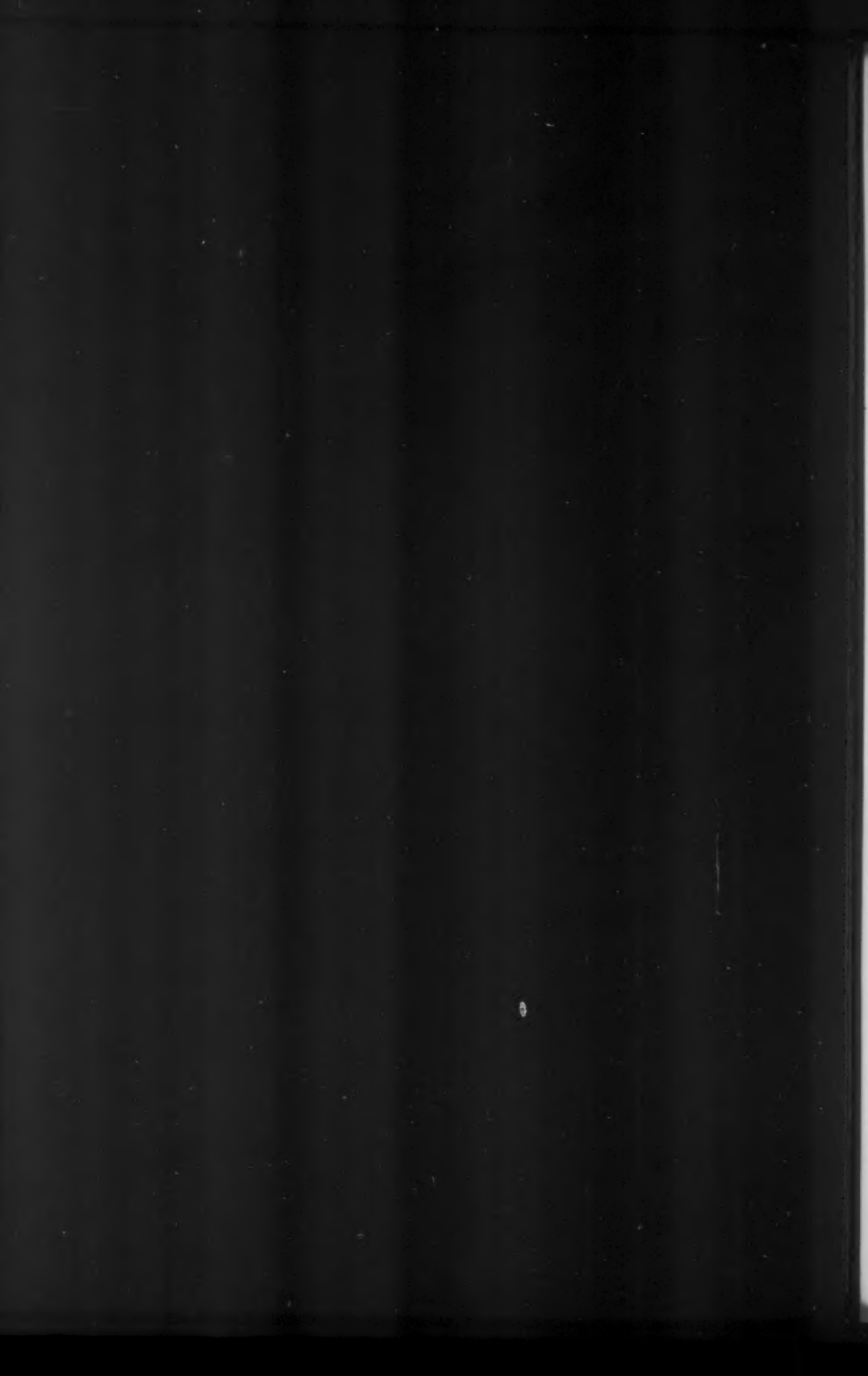
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# THE LARYNGOSCOPE.

VOL. LIII

JULY, 1943.

No. 7

## THERAPY OF DEAFNESS. REPORT OF CASES.\*

DR. LOUIS GUGGENHEIM, Los Angeles.

Since the beginning of otology there has existed an attitude of defeatism toward deafness. Quite early, otologists split into two groups: a very small one, priding itself upon a frank refusal to undertake any form of treatment, but suggesting lipreading and, more recently, a hearing aid; and a larger group, treating all cases of deafness with inflation or bougie.

Both groups, I believe, have erred. The first by refusing to study their cases of deafness from all possible angles and for failing to experiment; the second group, by continuing a form of treatment which years ago was recognized as a futile gesture except in such acute conditions as serous transudate, mucous exudate, etc. Fortunately, through the years, there have always been a few otologists, research-minded and unwilling to accept as final the prevailing conviction that nothing could be done for deafness.

## TESTING HEARING.

In the evaluation of any form of treatment the question of greatest importance is how to test the hearing before and after the therapeutic effort. That question would seem to have been satisfactorily answered, judging from otological literature of the day. But is it settled?

Audiometry is today accepted as the sole method of hearing measurement. Testing with the voice has been discarded.

\*From the Department of Otolaryngology, University of Southern California.

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When the audiogram remains unchanged and the patient hears speech better, the improvement is ascribed to suggestion or to training from repeated testing. On the other hand, any improvement in the audiogram is accepted as improvement in hearing; recent publications presenting changes as small as 2 and 3 db., despite the fact long accepted that variations of 10 db. are commonly encountered even after a few minutes' interval between tests.

There can be no argument concerning the fact that the audiometer is the sole means in our possession for precision testing of cochlear function. The cochlea is, however, only one part of the hearing mechanism. Other parts are not adequately tested with the audiometer.

#### THE HEARING APPARATUS.

Both auditory end-organs are connected with the auditory centers in both temporal lobes (general auditory centers) where sound is perceived and probably evaluated as to pitch and intensity. The audiometer with its pure tones at octave intervals serves then to acquaint us with the state of cochlear and general auditory center function. When that very complex sound phenomenon called speech is transmitted through the cochleas to the temporal lobes an additional series of events must transpire before speech is heard and understood. From both temporal lobe auditory centers the sound complex called speech must pass to the center of Wernicke in the left temporal lobe (in right-handed individuals) before the significance of words is registered. From Wernicke the sound complex must travel further through various pathways to higher psychical centers before full comprehension can occur. The concept (concept appreciation) is the desired result in the hearing of speech. An intelligent adult with impaired hearing hears two words of a sentence and comprehends: the less gifted adult or a child will hear all but two words of a sentence and fail to comprehend. It would be interesting but most difficult to ascertain just how many of the words spoken to him in one day, a normal hearing individual actually hears. If asked, he would answer, "I have heard every word spoken to me, of course. My hearing is quite normal." Probably he has heard only two-thirds of the words, or fewer.

Pure tones at normal threshold are practically nonexistent in the life of human beings. The things that do exist are speech, combinations of pure tones in music and combinations of tones in noises; all of these far above threshold. Yet we are told that we may judge of an individual's hearing by testing his ability to hear pure tones at threshold.

There are, further, a multitude of factors which influence audiometry. An individual with musical talent, innate or through training, will hear better than one with no musical ability. The power of concentration is important. A stable individual will make a far better showing than a neurotic one, disturbed by fears and doubts. I have patients whose audiometry varies 15 db. with rest and fatigue; others who during and before menstruation show over 10 db. variation.

Audiometry, then, although the most accurate means of testing cochlear function, is not a test of hearing. The complete dependence upon the audiometer, to the exclusion of all other tests, justifies the statement that the audiometer has become an otologic fetish.

In order to avoid being misunderstood it is well to emphasize at this point that no case of impaired hearing has been adequately examined until several audiograms both by air and bone conduction have been made. I use two machines, the Sonotone and the Maico, and in a soundproof room. I am never satisfied with an examination until two audiograms are made of both air and bone conduction. This does not, however, complete the test of hearing. A voice test is made in a quiet place with residual air and the distance is measured with a tape. With face turned away from the examiner and both ears open, whispered voice and conversation voice are used for sibilant numbers, nonsibilant numbers and then sentences. Next, each ear is masked by having an assistant rub a piece of paper placed over the untested ear. It is astonishing how well some patients hear, whose audiograms are quite low, and how poorly others hear, whose audiograms give the impression of very moderate impairment. Voice tests and audiograms may harmonize or they may be widely divergent. To discard the voice test and place full dependence upon audiometry is unscientific and impractical.

It has been my experience that when audiometry consistently shows an improvement within the speech range of over 10 db., the voice test usually shows an improvement in hear-

ing. Many patients, however, showing an unchanged audiogram have manifested marked improvement in hearing with the voice test. When the voice test shows improvement and the patient volunteers that under various circumstances he has noted definite improvement, and when family, friends and teachers are convinced of improvement, are we to smile and say, "No, there can be no improvement in your hearing since you are hearing the faintest possible intensity of pure tones exactly as you did before. Your improvement is psychic, not real." When we do this, we blind ourselves with a fetish very much as the shut-in research worker who announced to an audience of practicing physicians that he had made an observation in his laboratory which would revolutionize human existence: then continued, "On 1,000 white rats, etc., etc." Science long ago discovered that in some respects humans and rats are different. How can we explain an improvement in hearing in the presence of an unchanged audiogram?

In psychic deafness the patient is unable to hear anything. It is impossible to arouse him from sleep with noise or speech. After rest and psychotherapy hearing usually returns to normal. There can be no doubt that in these cases the inability to hear was not due to any abnormality of the end-organ but to central factors. Many of these cases were reported during World War I.

In normal sleep some individuals will not awaken until loudly and repeatedly called by name. The temporary deafness is central. Further diminution of hearing in nervous and fatigue states noted by many cases of impaired hearing, I believe, is due not to fatigue of the cochlea or VIIIth nerve but to disturbed cortical metabolism. The more primitive vestibular apparatus reacts quite normally during these nervous and fatigue states.

Every otologist has observed decreased hearing in females just before and during menstruation. Again we are dealing with altered cerebral metabolism and not with cochlear change.

One of the most interesting examples of improved cerebral hearing is in the markedly deafened adult whose hearing improves through oft-repeated stimulation of the cortex by

means of the Phipps bone conduction unit. When this work, carried on by the Morkovin group<sup>1</sup> at the University of Southern California, was first brought to my attention, I mentally categorized it along with the many vibratory machines that have appeared in the past. After visiting the Morkovin clinic and speaking to a number of deafened adults who had been through the training, I was forced to realize that something real was being accomplished with the Phipps unit. Many of these patients have suffered so marked a degeneration of the auditory end-organ that hearing aids were of no value. After years of intense exertion to hear, the effort had been too great to continue. The cortex gave up. Several of these people have told me that prior to their training, the radio was just a jumble of sound. No melody was heard; not even a perception or differentiation between instruments. After training with the Phipps unit they can now enjoy the radio; distinguishing the various instruments and following the music with ease. Surely no change has occurred in the end-organ; the cortex has learned to function again. Quoting from a recent report of the Morkovin group: "The Hearing Clinic of the University of Southern California is doing research in aural education on the basis of the following assumption: The understanding of vocal speech involves not one but several abilities as concerned 1. with simple auditory thresholds, 2. with sensory organization and ability to form patterns out of incoming excitations, and 3. with attachment of meaning to sounds.

As a consequence of this assumption which is shared with us by leading American psychologists, Dr. J. P. Guilford and Dr. Knight Dunlap among others, the training of residual hearing can be done successfully in many types of hearing impairment. Some outstanding otologists and physicists, like the late Dr. C. C. Bunch, are in agreement with us as to the explanation of successful cases of perceptual education of residual hearing when the improvement in understanding spoken words is not accompanied by change in the audiogram. In such cases the improvement is apparently due not to any histological change in the end-organ but to the improved cerebration. Dr. M. H. Lurie, of the Harvard School of Medicine, and Dr. S. S. Stevens, of Harvard University, Department of Psychology, also accept the explanation of the nature of aural education as stimulation of attention to

speech sounds resulting in more accurate analysis and discrimination, whether it is done consciously or unconsciously."

Not infrequently, patients with marked impairment, after using a hearing aid for months and under no treatment, find they can get along better without the aid than before using it. Mr. Ralph G. Watson, of the Maico Company, told the writer of a man, age 40, who had used an aid for six months and now hears better without the aid than he did when the aid was prescribed. His audiogram is unchanged.

These various experiences force us to conclude that whereas the audiometer is the most precise method of measuring cochlear function, it is not a test of hearing in the broader sense.

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In discussing the treatment of deafness it is well to consider not only disease entities such as otosclerosis, tympanic fibrosis, etc., but to consider also anatomic divisions of the auditory apparatus and their amenability to therapeutic effort. This is necessary because many aural pathologies involve more than one anatomic division and considered alone would be confusing. For example, otosclerosis is not only a new bone formation which may lead to ankylosis of the stapes, etc., but is in many instances also a condition involving the neural mechanism.

Pathologically we are primarily interested in whether a condition is reversible or not. An impaction of cerumen may cause impaired hearing. It is easily reversible. Conduction deafness due to a tympanic vacuum may be cured by removing lymphoid tissue from the nasopharynx and by producing resorption of tubotympanic mesenchyme. Early tympanic fibrosis in children can often be completely reversed by adequate tympanic ventilation. Prolonged suppuration in acute otitis media with progressive loss of hearing can be cured and hearing saved by posterior drainage. In mucous exudate of the tympanum, fibrosis can supervene if the exudate is not expelled. Myringotomy followed by inflation usually prevents the fibrosis and permanent impairment of hearing. The focus of dystrophic bone in otosclerosis enlarges through the outgrowth of osteogenic marrow into the surrounding areas of resorption. It is now possible to influence this resorption with diet, calcium, phosphorus and vitamins.

The possibility of regeneration of neural tissue in the end-organ depends upon the degree of degeneration which has occurred. Where the cells of the spiral ganglion have disappeared there is no hope of reviving them. When the axis cylinders in the ramus cochlearis have undergone granular disintegration there is no possibility of restoration; but in all neuropathies there is a phase still amenable to treatment. The earliest effect of toxemia, of vitamin B deficiency, of pressure, etc., is cloudy swelling of the neurilemma. If in this stage the etiologic factor is removed and intensive vitamin B complex therapy is instituted, a *restitutio ad integrum* is possible. If spotty degeneration of the neurilemma has occurred the prognosis is less favorable. When the neurilemma has been destroyed and granular disintegration of the axis cylinders has begun, treatment will be of no avail. Pressure from ectasia of the scala media in Ménière's disease, from tumors of the nervus acusticus and from otosclerosis will result in irreversible atrophy if the process is not interrupted in time. In otosclerosis the pressure cannot be removed, but vitamin B therapy tends to inhibit degeneration.

#### PROPHYLAXIS.

It is well to keep in mind at all times the main function of the ear. Involvement of the vestibular apparatus may produce alarming symptoms and this division of the ear may finally cease to function but compensation except in intracranial involvement soon takes place and the function is not missed. When cochlear function is impaired or lost, the loss is permanently sensed. How very important, then, is the prevention of deafness!

When dealing with acute infection one's mind is absorbed with the suppurative process; with the possibilities of mastoid involvement, petrositis and intracranial complications; cochlear function is often neglected.

It is important in every case of acute otitis media to test the hearing frequently. By rubbing a piece of paper over the unaffected ear, a quick and satisfactory estimate may be made at the bedside and recorded. As discharge becomes more mucoid and resolution is under way, hearing should begin to improve. If it doesn't improve or if it grows worse, two things may be indicated. Even in the absence of mastoid



symptoms, if suppuration is continuing too long and hearing shows no improvement or is growing worse, a simple mastoid exenteration will usually cure the tympanal suppuration and restore the cochlear function. If, for any reason the mastoid exenteration is not performed, large amounts of the antineuritic vitamin B, and niacin should be administered. Even where the operation has been performed and until hearing has revived, these vitamins are indicated. Depending upon the degree of impairment, the dosage of thiamin hydrochloride should be from 20 to 100 mgm. daily intramuscularly and an additional 5 mgm. three times daily by mouth. Niacin in doses of 25 mgm. five times daily may be given orally in addition to 25 to 50 mgm. or more intramuscularly twice daily.

In serous transudate or in mucous exudate into the tympanum, while simple inflation is being tried, the hearing should be checked daily. Myringotomy, particularly in mucous exudate should not be deferred too long as tympanal fibrosis with permanent impairment may supervene.

Pediatricists should be impressed with the importance of administering the antineuritic vitamins in the acute infectious diseases of childhood. I believe in this way it may ~~become possible to prevent the tragic deafness we occasionally observe following mumps and other childhood diseases.~~

There are still obstetricians who ridicule the possibility of deafness in a child following quinine administered to induce labor. These cases are not uncommon. It is the duty of the otologist to enlighten his colleagues in other fields as to this possibility.

The problem of protecting the ears in industry is very complex. It is difficult enough to convince the managers of the necessity of excluding from the ears a part of the terrific noise, but still more difficult to make the workers co-operate. In the ship-building industry, for instance, where the noise outside the hull is 100 db. loud and very much more intense inside, earplugs, molded to fit the external canals, have been supplied but many of the workers wear them in their pockets. Hunters may suffer degenerative changes from repeated impact of the explosive noise. Most of them are entirely unaware of the danger until tinnitus and impaired hearing have supervened.



If dieting women and ageing individuals were taught to supplement their diminished food intake with adequate vitamins we would probably encounter less nerve deafness in these groups.

In the prevention of deafness from otosclerosis, methods in order of importance are: 1. no propagation by otosclerotics, 2. no marriage between two otosclerotics, 3. early diagnosis of otosclerosis in order to prevent as far as possible enlargement of the focus and neuropathy. All children should have tests of hearing from three years onward. Particularly important, of course, is the early and repeated examination of children of otosclerotics.

If one were too much impressed with Cordia C. Bunch's observation of a few otosclerotic women over a period of a few years, or if one took too seriously George E. Shambaugh, Jr.'s, analysis of Bunch's report,<sup>2</sup> one might readily conclude that Politzer and the numerous observers since have erred in looking upon otosclerosis as progressive deafness and that an otosclerotic woman has little to fear from pregnancy. Every reader of this article will have observed a sufficient number of otosclerotic women who have suffered further loss of hearing following pregnancy, not to be misled by Bunch and Shambaugh. It is true that some otosclerotics do go for years without increase of deafness and some go through pregnancy without further loss of hearing, but otosclerosis is still progressive deafness and pregnancy is still a hazard. At this point I would like to say that the approach to the subject of pregnancy is often brutal and psychologically unsound. The frequently used admonition, "you must not have a child because you may become quite deaf and the baby may inherit the condition," is open to criticism. The prohibition intensifies the desire which battles with the twofold fear to produce a conflict which may give a dire psychologic effect. I believe a more humane and a more scientific approach to the subject is as follows: "You have an ear condition which is hereditary. It has been shown that where there are several children one of them may develop the malady and others may transmit it without themselves suffering impairment of hearing. Sometimes otosclerotic women manifest a further loss of hearing after pregnancy. For these reasons the subject should be thought over carefully. Anyway, it would be advisable to await the outcome of treatment before having a baby."

This leaves the woman with a choice of having a baby or not. She has been given facts to consider and carefully weigh. In time she adjusts herself to the idea of not having a baby, without being profoundly shocked. In time, adoption may be suggested.

#### TREATMENT.

The present research has extended over six years: 1937 to 1943. Improved hearing has resulted from alterations in aural pathology, from better cerebral perception or from a combination of the two.

The most satisfactory cases have been children under 13 who had impaired hearing from simple lack of adequate tympanal ventilation, from early reversible tympanal fibrosis, from unresorbed tubotympanal mesenchyme or most frequently from a combination of all three factors.

#### UNRESORBED MESENCHYME.

The ideally normal ear at term shows complete disappearance of mesenchyme from the tunica propria of the Eustachian tube and tympanum. Most ears, however, carry some mesenchyme through to the fourth or fifth year. This may do no harm if there is no tubal obstruction from adenoid tissue. The combination often leads to trouble. While to my knowledge no experimental work has been done on the effect of pressure upon mesenchyme, clinical experience suggests that resorption of this gelatinous tissue occurs after pressure with the Gerjoye tubal dilator. This instrument has been used successfully in children who did not improve after direct adenoidectomy alone. The improvement in hearing following the application of radium may be the result of its effect upon mesenchyme. I have not used radium and its ability to cause lymphoid tissue to disappear has been questioned by E. P. Fowler and others.

Lurie, of Harvard, reported disappearance of tubotympanal mesenchyme in rats after the administration of anterior pituitary extract.

Several years ago I repeated this experiment but the results were not definite enough for report.

The early resorption or late disappearance of mesenchyme seems to be governed by heredity and may manifest itself

similarly in a number of children in the same family. It is a common experience to encounter repeated otitis media in several children of one family while in other groups, even with frequent upper respiratory infection, no otitis media ever occurs. Probably the persistence of mesenchyme in the former group is one factor that accounts for the otitis media.

#### REVERSIBLE TYMPANAL FIBROSIS.

Adult fibrosis of the middle ear is irreversible since scar tissue is final and unchangeable except with knife or cautery; therefore, a tympanic cavity webbed with fibrous tissue is not amenable to any attack clinically warranted.

In children another form of tympanal fibrosis is very frequently present. As a result of tubal obstruction from adenoid and mesenchyme, serous transudate or subclinical inflammatory exudate may occur. These conditions usually cause no pain and are often overlooked; but when the obstruction persists, differentiation of certain cellular elements into immature connective tissue occurs. For a number of years this tissue is capable of being dedifferentiated into fibroblasts which are mobilized and finally disappear with complete *restitutio ad integrum* of the conduction apparatus. Improvement in hearing after direct adenoidectomy<sup>3</sup> and tubal dilatation usually takes from three to six months. Mobility of the malleus becomes normal and retraction of the membrana tympani disappears.

#### TYMPANAL VACUUM.

In cases where hearing improves very soon after direct adenoidectomy and tubal dilatation, I believe there has existed only one deterrent to sound conduction; namely, lack of tympanal ventilation with retraction of the membrana tympani and immobility of ossicles.

#### OTOSCLEROSIS.

In treating progressive deafness three different factors are involved: 1. prevention of spread from the focus of dystrophic bone; 2. reversal of neural injury; 3. alteration of cerebral metabolism with improvement in perception and interpretation of sounds.

It has long been known that the dystrophic osseous focus enlarges through the outgrowth of osteogenic marrow into the surrounding zone of preparation (area of bone resorption). The writer, together with Lewis Gunther, Victor Goodhill and Mary Irvine<sup>4</sup> showed that in rats, decalcified bone of the aural capsule can be converted into normal osseous tissue through diet adequate in calcium, phosphorus vitamin D, etc. Even before this research, there was ample clinical evidence that dietary regulation, adequate calcium, phosphorus and vitamins can sometimes prevent otosclerosis from being progressive.

The procedure is to analyze a seven-day record of food intake, regulate the diet according to the individual requirement; give calcium and phosphorus in the form of dicalcium phosphate, and administer vitamins.

The neural degeneration which occurs in otosclerosis is probably due to pressure on the ramus cochlearis at the internal meatus and to the ingrowth of dystrophic bone in the round window region and possibly to other as yet unknown factors. As in other neuropathies of the ear, if taken in an early phase when there is no granular disintegration of the axis cylinders, regeneration with improvement of hearing may result from intramuscular injection of vitamin B complex. It has been found that insulin increases the effectiveness of thiamin and niacin. At the same time the patient receives the B. complex orally. The absence of improvement from vitamin therapy in a number of recent reports may have been due to two things: first, the too brief therapeutic effort; second, to the fact that audiometric tests alone were used.

#### CEREBRAL METABOLISM.

In all forms of deafness we are dealing not only with an end-organ pathology but also with a central problem. When impairment is sufficiently advanced to make certain hearing situations an effort, the fatigue element appears. Depending upon the constitutional make-up of the individual, varying degrees of effort will be tolerated before the attentional concentration weakens. I know people with impaired hearing but of sound neural constitution who can concentrate upon conversation among a number of people with effort but also with a feeling of triumph and even stimulation from the experi-

ence. Others with a less stable make-up are quickly exhausted, frustrated and deeply depressed. The effect of dietary regulation and vitamin therapy has been to decrease fatigue, improve attentional concentration and produce a general feeling of improved health. Accompanying this improved state of health there is often a marked improvement in hearing.

When we speak of improved cerebral metabolism we do so with no actual knowledge of what transpires centrally but we do know that an individual in good general health can usually cerebrate better than one in poor health.

One of the most amazing things about otologists is their belief that we hear solely with our ears and that, therefore, the goal should be a complete understanding of the temporal bone and the complex apparatus therein contained. Although the central ramifications of the rami cochlearis and vestibularis are now known, the pathology of these ramifications has received scant attention. Not even the brain stem is sectioned and studied in our otological laboratories. Clinically and pathologically, in impaired hearing, we have never gone beyond the internal auditory meatus and the cerebellar pontile angle.

Among normally hearing individuals certain auditory phenomena are food for thought. First, in hearing speech we depend not so much upon hearing individual words as we do on speech patterns to which our brains have become accustomed. Under certain conditions even familiar patterns fail to register. One recalls the old story of the bored society man who, weary of the selfishness and frivolity of his set, announces to each person at a crowded reception, "I died yesterday." The reactions were an indulgent smile, "That's fine," "Good for you," etc. Not one person had heard what he said. Each one was too preoccupied with his own thoughts and plans to hear what anybody else had to say. An individual sits reading in a room with lively conversation going on. He hears nothing of the talk about him. The neurotic patient, obsessed with conflicts and fears about his physical condition, appears to listen to his physician but hears nothing and telephones in an hour later for a repetition of instructions. A sound sleeper may be talked to in ordinary conversation intensity and not hear, sleeping calmly on until his name is loudly called.

In psychic deafness all conversation may fail to be heard. In all these instances the end-organs are normal and sound stimuli pass from cochlea to temporal lobes (general auditory centers) but no further. It is certainly incorrect to say that one hears when comprehension is lacking. Speech patterns are heard when sound stimuli flow smoothly from drum membranes to the higher psychical centers. When blocking occurs and speech is not comprehended, there exists impaired hearing. This impairment may be based upon organic changes or it may be functional, permanent or temporary.

It is for these reasons that we must include in the apparatus of hearing not only the end-organs but all central ramifications. It is for these reasons that the entire organ of hearing deserves study. And it is for these reasons that therapeutic effort should be directed not only to the temporal bone but also to the brain.

Improvement in hearing can result from alteration in end-organ pathology; but let us emphasize, hearing most surely can also improve from alteration in cerebral function.

All humanity may be divided into visile, audile and the mixed type. The characteristics of each type are related to hearing potentialities. In early life it is possible to alter somewhat these innate characteristics.

The easiest way to define visile and audile is to describe the reading habits. A pure visile, which is uncommon, never sounds what he reads. He understands what he reads exclusively through visual impression of the printed or written word. Such individuals read very rapidly; some have the remarkable ability to understand a printed or written page by glancing from top to bottom instead of looking at each line from left to right.

A pure audile cannot understand a single sentence without sounding each word, mentally, although he is able to understand visually a single word such as a label on a bottle. Audiles necessarily read slowly and rather laboriously.

The mixed type is most common, with one or the other characteristic predominating.

Through early training an audile can be made to approach the abilities of the visile. No attempt has ever been made, so

far as I know, to produce an audile out of a visile as there is every advantage in being a visile as far as reading is concerned; however, in relation to hearing, the problem may be different.

An individual who can read and understand without effort, in a room in which lively conversation is going on, is more of a visile than an audile. A pure audile can concentrate upon a book under such conditions only with the greatest effort since there is conflict between what he is trying to hear mentally from his book and the bombardment of his sensitive hearing centers from the extraneous conversation. No experimental work to my knowledge has been done but my personal experience is that audiles possess a more sensitive hearing apparatus.

Further observation may show that visiles are less amenable to treatment of hearing impairment than audiles.

#### TYMPANAL FIBROSIS IN THE ADULT.

There is no treatment known which will alter this pathology of the conduction apparatus, but the same psychological and cerebral metabolic factors exist here that are present in other forms of deafness. Improvement in general health will often be accompanied by improved concentration and better hearing.

#### NEUROPATHIES OF THE EAR.

In nerve deafness of childhood I have seen improvement in hearing from prolonged vitamin B complex therapy. One may presume that in these cases early neurilemma changes have been repaired. In later years with degenerations of long standing, we can only hope to improve hearing through better cerebation.

For one to believe that the injection of any vitamin B complex factor, regardless of dosage, over a period of two or three weeks could alter neural degeneration is for that individual to display a lack of familiarity with the literature. Numerous experiments have shown that it takes from one to two years of continuous vitamin B therapy to produce neural



repair. Superficial nerve tissue had been removed and examined at varying periods in these reported experiments.

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1033 Gayley Avenue.



## TUMORS OF THE LARYNX. A REVIEW OF 105 CASES.\*

DR. HORACE E. MITCHELL, Cleveland.

### INTRODUCTION.

In the past decade, there has been increasing interest in the problems of tumors of the larynx, particularly with regard to the treatment of malignant tumors. Laryngectomy and laryngofissure are performed with increasing frequency and by an ever increasing number of otolaryngologists. The results in individual cases are sometimes so striking and encouraging that they may be productive of false optimism regarding the results of treatment as a whole. In order to check some impressions I have had with the actual facts as disclosed on the hospital records, I have reviewed 105 cases of tumor of the larynx seen by myself and my associates at two hospitals during the past few years.

Although treatment has been productive of most gratifying results in some instances, this review shows only too plainly that there is much still to be achieved in the management of cancer of the larynx. The distressing fact is that the vast majority of patients do not seek treatment until the lesion is far advanced and symptoms are severe; in fact, many patients in this series did not enter the hospital until they were found in the last stages of the disease, some of them in a moribund state.

That laryngeal surgery has been perfected by improved technique and teaching is of little use to the patient whose lesion is far too extensive to warrant operation. Although otolaryngologists cannot justly be blamed for this negligence on the part of the public, it seems justifiable to raise the question whether we have done all we could, as a group, to educate and inform the people regarding the early symptoms, particularly hoarseness, and to let them know of the satisfactory

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results achieved in this type of cancer when treatment is instituted early.

*Incidence:* Jackson and Jackson<sup>1</sup> have recently discussed the incidence of cancer of the larynx. There is a small but progressive increase from year to year, the cause of which cannot be definitely determined. These authors suggest that the increase of hours spent on the highways with tarred road surfaces and inhalation of gasoline fumes may be one factor. Increased use of tobacco and alcohol in women may show some interesting statistics in the next decade. Jackson and Jackson have reduced the incidence of carcinoma of the larynx to its simplest terms, as follows: About one person in every hundred dies every year; about one death in every hundred is due to cancer; about one of every 100 deaths from cancer is due to cancer of the larynx.

In this series of 105 cases, 83 were malignant tumors, one doubtful, and 21 benign. That is, there were about four times as many malignant tumors of the larynx as there were benign. If the six children with papilloma of the larynx were excluded, the ratio of malignant to benign tumors in adults is about  $5\frac{1}{2}$  to 1. This fact underlines the importance of hoarseness as a danger signal in adults, for this is the most persistent symptom in the entire group, including those with both malignant and benign tumors.

*Etiologic Factors:* All authors have stressed the importance of alcohol and tobacco as etiologic factors in cancer of the larynx. In this series it was impossible to determine the exact number of cases in which tobacco and alcohol were used to excess, for this was not accurately recorded; however, there were several chronic alcoholics among them, others who drank to excess, and many more who used large amounts of tobacco.

Chronic irritation of the throat is another factor of importance, and one patient in this series had had cough and tickling in the throat for at least 25 years. Several others had had similar symptoms for shorter periods.

Benign tumors cannot be overlooked as a factor in the production of cancer. Four patients in this series had had benign papillomas for several years before there was any evidence of malignant change. One of these was the one woman in the

group with cancer, and she had had a papilloma of the larynx removed three times before a fourth biopsy revealed squamous cell carcinoma. In the series reported by Peck, Maxwell and Lamberson,<sup>2</sup> two cases of carcinoma developed in a gumma and five others in a benign polyp of long standing. Their total series numbered 170 cases of carcinoma of the larynx. In Clerf's<sup>3</sup> series of 250 cases of cancer of the larynx, three patients had had a previous benign papilloma of the larynx. Orton<sup>4</sup> also reported three (in a series of 102 cases) of cancer that developed in a benign papilloma.

Tucker<sup>5</sup> also has stressed the importance of the inter-relationship of benign to malignant lesions in the larynx. He points out that they have many factors in common: the site of the lesion, etiologic factors of local irritation by functional trauma, external irritants and use of tobacco and alcohol. The normal transitional change in cutaneous membrane of the larynx due to advancing years would supply the basic etiologic background for benign lesions becoming malignant in those persons with a predisposition to the development of cancer. As a preventive measure in the development of cancer, removal of benign tumors and restoration of normal contour and function of the cord may be important.

*Sex:* There was only one woman among the 83 patients in this series with cancer. The case of doubtful malignancy was in a man. Other authors have reported a somewhat higher incidence of cancer of the larynx in females. In Peck's<sup>2</sup> series, there were 140 males and 30 females. Clerf<sup>3</sup> had 233 men and 17 women. In Hammond's<sup>6</sup> series of 15 cases, one was a woman. Orton<sup>4</sup> reported 11 women in 102 cases.

In the patients with benign tumor in this series, 14 were male and seven female.

*Age:* The age of the 105 patients in this series corresponds closely with that of other reported groups. The highest age incidence of the cancer group was between 50 and 60 years (33 patients), and more than 90 per cent were between 40 and 70. There were four between 30 and 40 years; 18 between 40 and 50 years; 33 between 50 and 60 years; 24 between 60 and 70 years; and four past 70.

The patients with benign tumors were much younger, on the average. Six of the 21 were children under 10 years of

age. Two were between 20 and 30; six between 30 and 40; four between 40 and 50; and one each in each of the next decade age groups. The patient whose lesion was doubtful was 55 years old.

There were two negroes in this series, both with cancer of the larynx.

#### DIAGNOSIS.

The diagnosis of cancer of the larynx is made from the history and physical examination, in the majority of cases, but the laryngoscopic examination and biopsy are necessary for complete accuracy. The extent of the lesion can be determined only by laryngoscopic examination, in numerous instances; and a pathologic diagnosis is essential in all cases, because some apparently benign lesions show malignant change in the histologic examination.

The biopsy should be routine in all cases, because in this series there are four instances of recurrent papillomata which eventually were malignant. Nor should one biopsy be regarded as sufficient, if a benign lesion is reported in a tumor that is clinically suggestive of malignancy. In this series there were four cases in which repeated biopsy was necessary in order to establish the diagnosis of malignancy. In another case in which the pathologist's report was hyperkeratosis and chronic inflammation, the diagnosis of carcinoma was made. Because the disease in the larynx was clinically malignant, the patient displayed a steadily downward course which terminated in death.

*Symptoms:* Hoarseness is the outstanding symptom of tumors of the larynx, both benign and malignant, and was exhibited by practically all the patients in this series. In many instances, however, this was not the symptom which prompted the seeking of medical treatment; for many patients neglected the condition until dysphagia, dyspnea or inability to swallow or breathe forced them to seek relief.

Clerf<sup>7</sup> has repeatedly emphasized the importance of hoarseness in cancer of the larynx. He says that the lesion begins in the anterior half of a vocal cord in about 80 per cent of cases, and any lesion of the vocal cord which prevents proper approximation, vibration or tension of a cord produces voice changes. Huskiness or hoarseness, therefore, should be an

early and constant symptom of cancer of the larynx, as indeed it is, according to the series reported here and other reported reviews.

In this series of cases, hoarseness had been present from a few weeks to many years before treatment was sought. Often obstructive symptoms, such as dyspnea, cough and difficulty in swallowing had been present for a period of months or years, and these too were neglected until they were so severe that treatment was imperative. In several instances the obstruction to respiration was so severe that the patient was cyanotic on admission and required emergency tracheotomy as soon as possible.

*Pathology and Extent of Lesion:* The important factor in diagnosis of cancer of the larynx is differentiation and selection of cases for various types of treatment. Intrinsic lesions limited to one cord respond well to laryngofissure; but with improvement in the technique and experience in the use of laryngectomy, the latter operation is preferred by many otolaryngologists, because it so often is difficult or impossible to tell how far the lesion may have extended.

Neglected lesions which may have been intrinsic primarily, and extrinsic lesions of the larynx may be operable, depending on the grade of malignancy and the extent of the involvement; but in many of these, operation is impossible, and the only recourse is to Roentgen irradiation and radium with palliative procedures such as tracheotomy and gastrostomy.

In this series of cases, almost all were late and extensive. In the series of malignant cases, the following pathologic diagnoses were made: squamous cell carcinoma (poorly to well differentiated), 62 cases; possible sarcoma, one case; carcinoma, eight cases; carcinoma simplex, six cases; and hyperkeratosis and chronic inflammation (clinically malignant), one case; epithelioma, one case.

Squamous cell carcinoma is the most important pathologic lesion in this series, and is similarly preponderant in other reported series. In Orton's<sup>4</sup> cases, 75 per cent had squamous cell carcinoma; and Clerf<sup>7</sup> has made the statement that practically 96 per cent of vocal cord cancers are of the squamous type.

The degree of differentiation is important in choosing surgical or radiation treatment and in making the prognosis. In lesser degrees of malignancy, of course, the results of surgical treatment are much more satisfactory and the prognosis is better.

#### TREATMENT.

The treatment of carcinoma of the larynx should be surgical whenever the extent of the lesion will permit operation. In early, intrinsic cancer of the larynx, laryngectomy usually is preferable, although laryngofissure may suffice in properly selected cases. In the case of extensive lesions, often only irradiation and palliative procedures may be employed.

*Laryngectomy:* In this series of 83 cases of carcinoma of the larynx, laryngectomy was justified in only 11 instances. Of these patients, six are alive and well; one for 10 years; one, 4½ years; one, three years; one, two years; one, a year and a half; and one, 14 months. There is no follow-up record on two patients. One lived two years and three months after laryngectomy; one with an advanced extrinsic lesion lived six months; another lived five months after operation.

The patient who has lived for 10 years did not present an ideal case for operation, because he had had hoarseness for two years, and dysphagia and difficulty in swallowing for several months, at the time he was first examined. The pathologic report was squamous cell carcinoma.

This case illustrates the importance of careful consideration of all cases of laryngeal cancer, from the standpoint of surgery, for no patient who is likely to respond should be denied the benefits of life and health that may result from a radical laryngectomy.

*Laryngofissure:* Of the four patients in this series who had laryngofissure, one is alive and well five years after operation, and another, 1½ years. The other two had advanced lesions and died four months and seven months, respectively, after the operation.

*Tracheotomy:* That tracheotomy was the operation performed most frequently in this series of cancer of the larynx is another indication of the advanced stage of the disease in most of the patients. Tracheotomy was performed in 27

cases, in several instances as an emergency measure, on admission.

*Gastrostomy:* Gastrostomy was performed in four instances. In three cases, it succeeded in prolonging life for a time. In the other two cases, the patient died soon after the procedure.

*Radiation Treatment:* Most of the patients in this series who did not die soon after admission received Roentgen irradiation, and about 20 had radium implantations in addition. While otolaryngologists have been improving the technique of surgical procedures, radiologists have been giving attention to improving the results of radiologic treatment of cancer of the larynx. Lenz<sup>9</sup> and Coutard<sup>10</sup> have made particularly noteworthy contributions to the subject. Lenz has pointed out that the failures of irradiation are due both to local peculiarities of the tumor and tumor bed and to faulty treatment. Reduction of failures in the first group must come through earlier diagnosis and improvement in the latter group must come from avoidance of under- or overdosage.

Coutard has formulated some criteria for radiosensitivity on the basis of the histologic picture. Differentiated growths in which there is also fixation of tissues are radioresistant while undifferentiated growths yield well to irradiation treatment. Those of the cutaneous type, well differentiated, show the minimal radiosensitivity. If the lesion is extensive, prognosis should be guarded, because some lesions seem mobile at the periphery but at the central focus are fixed and infiltrating. Median types are more easily curable than anterior, and posterior types are rarely curable by radiation. High daily doses are essential, and are more important than the total dose. Cutler<sup>11</sup> has found that the most important indication of radiosensitivity is the mobility of the lesion and surrounding structures.

I agree with Crowe and Broyles<sup>12</sup> that Roentgen and radium irradiation are sometimes effective, but their use is too uncertain to warrant employing them in place of surgery when the growth is operable; they may be useful in combined treatment. When operation is not possible, naturally irradiation is the only recourse.



## CARCINOMA OF THE LARYNX.

## Cleveland City Hospital.

No.	Sex	Age	Symptoms and Duration	Clinical Diagnosis	Treatment	Pathologic Diagnosis	Outcome
1	M	45	Hoarseness 1½ yr. No pain. 2 biopsies showed no evidence of malignancy. 3rd biopsy showed squamous cell carcinoma.	Tumor of right vocal cord. No extension beyond vocal cords and across anterior commissure.	Total laryngectomy.	Squamous cell carcinoma.	Discharged to OPD and last seen there 4/8/42 with no evidence of recurrence. Working in September, 1942, as park attendant.
2	M	58	Hoarseness, 6 mo. Dyspnea. Weight loss, 30 lb. Had consulted herb doctors and mechanotherapists.	Carcinoma of larynx with extension to surrounding structures.	Direct laryngoscopy, biopsy, tracheotomy and X-rays. Biopsy.	Well differentiated squamous cell carcinoma of larynx (extrinsic).	Discharged 6/4/42 to return to OPD for X-ray treatment.
3	M	56	Sore throat, dysphagia and inability to eat solid food for 2 mo. X-ray to treatment elsewhere before admission.	Possible carcinoma of left pyriform sinus.		mous cell carcinoma of pyriform sinus (extrinsic laryngeal).	Discharged in fair condition with poor prognosis 11/14/41. Advised to return for gastrostomy, when necessary.
4	M	52	Cough, 25-30 yr. Cough and hoarseness much worse past winter. Heavy drinker. Consumed a gallon of wine daily for 2 yr. and drank heavily before that.	Carcinoma of left ethmoid sinus.	Laryngoscopy, biopsy, X-ray 3,000 r to 3 fields.	Well differentiated squamous cell carcinoma of left pyriform sinus, seat of severe acute and chronic inflammation.	Patient in hospital 2 mo. Discharged 7/5/41. Died 4 mo. later.
5	M	32	Inability to swallow, and dyspnea, 14 mo. Weight loss, 60 lb.	Carcinoma of larynx with metastasis to regional lymph nodes.	Tracheotomy. X-ray.		Returned to hospital 9 mo. later with extension and inability to swallow. Died.
6	M	44	Tender lump on left side of neck, 4 mo. Some dysphagia on left. Ulcerating lesion, left arytenoid.	Malignancy. Firm discrete node about 1.5 cm. at angle of left jaw.	Laryngoscopy and biopsy. X-ray. Radium implantation.	Partially differentiated squamous cell carcinoma of larynx and arytenoid glottic fold, left.	Readmitted month later with pain in throat, radiation given; last seen OPD 2/14/38 with very poor condition. Probably dead.
7	M	62	Hoarseness, 5 mo. Growth on left vocal cord.	Gumma or malignant tumor of left vocal cord.	Laryngoscopy and biopsy.	Well differentiated squamous cell carcinoma.	Died 1 mo. after discharge.
8	M	37	Hoarseness, 2 mo.	Sessile growth, left vocal cord.	Laryngofissure.	Squamous cell, well differentiated. Leucoplakia adjacent subglottic and ventricular fold. Tumor extends into cut margin.	Readmitted 2 mo. later, with increasing pain into neck. No evidence of recurrence. Last seen OPD 8/12/42 with no sign of cancer, 16 mo.



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9	M	48	Hoarseness, 11 mo. Had previous treatment for carcinoma of larynx (X-ray). Now has tumor left sternomastoid muscle at level of larynx, 3.5x3.2 cm.	Epiglottal tumor.	Radium implantation.	Squamous cell carcinoma with metastasis to left cervical lymph node.	Last seen OPD 2 yr., 4 mo. later. Epiglottis and arytenoid show no evidence of recurrence. No metastasis in cervical region.
10	M	48	Admitted because of injuries with skull fracture incurred after drinking from bottle. Tumor of vocal cord discovered in examination.	Carcinoma of larynx.	Laryngoscopy and biopsy (twice).	1. Chronic inflammation. 2. Poorly differentiated squamous cell carcinoma.	Patient refused hemilaryngectomy. Last seen in OPD 4 yr. later, with no progression of laryngeal disease.
11	M	46	Hoarseness, 5 mo. No pain, cough or weight loss. Cervical lymph nodes. Nodular growth, left ventricle, cord and posterior commissure. Right cord normal.	Carcinoma of vocal cord.	Direct laryngoscopy and biopsy.	Poorly differentiated squamous cell carcinoma.	Patient refused operation and X-ray treatment. Discharged 11/22/37, no follow up.
12	M	53	Difficulty in swallowing, few weeks. 2 lumps on neck, 6 weeks. Cough, 6 mo. 20 lb. weight loss in 2 mo. Firm fixed mass, 8 cm. diam., over sternomastoid muscle. No metastasis of mandible 2 smaller masses behind and below this.	Bronchogenic carcinoma with metastasis to cervical lymph nodes.	Biopsy of tissues, right pyriform sinus. Tracheotomy.	Carcinoma of right pyriform sinus with metastasis to cervical lymph nodes and lungs.	Patient had downward course and died 2 wk. after admission.
13	M	54	Laryngectomy had been done elsewhere 4 yr. before admission. Cough, blood from tracheotomy tube and rapid weight loss, 2 weeks. Also hematuria.	Recurrent carcinoma of larynx with extension into chest.	None.		Patient died day following admission.
14	M	62	Pain in throat, 10 mo.	Carcinoma of larynx.	Biopsy, epiglottic and rt. arytenoid region. X-ray.	Undifferentiated carcinoma of larynx.	Death few months later.
15	M	53	Hoarseness, 1 yr. Hemoptysis 1 occasion 6 mo. before. Slight chronic cough. No dysphagia. Nodules in glands of neck.	Carcinoma of larynx with local metastasis.	Removal cervical lymph nodes. Radium implantation.	Squamous cell carcinoma.	Died at another hospital 6 mo. later.
16	M	56	Hoarseness and some pain 14 mo. before. Treated at another hospital with X-ray and tracheotomy. Returned to work until 2 mo. before admission, when tracheotomy had been done.	Carcinoma of larynx.	Symptomatic.	Squamous cell carcinoma.	Patient died 11 days after admission.
17	M	52	Hoarseness, 18 mo. Also tickling in throat. Dyspnea, 1 mo. Infiltrating lesion, left cord extending beyond commissure to right cord.	Carcinoma of larynx.	Laryngoscopy and biopsy. Tracheotomy. Laryngectomy. X-ray 2900 r both sides of neck.	Well differentiated squamous cell carcinoma.	Patient returned to hospital with difficulty in swallowing and severe hemorrhage into nose and mouth 4 mo. after operation. Died 1 mo. later.

(Continued)

Cleveland City Hospital. CARCINOMA OF THE LARYNX—(Continued).

No.	Sex	Age	Symptoms and Duration	Clinical Diagnosis	Treatment	Pathologic Diagnosis	Outcome
18	M	54	Dyspnea, difficulty in swallowing, 5 mo. before admission. Much loss of weight.	Carcinoma of larynx with metastasis to neck.	Tracheotomy. X-ray treatment.		Patient readmitted 5 mo. later; committed suicide day of admission.
19	M	51	Dysphagia, enlarged glands in neck began with cold, 18 mo. before. Could take only liquid foods for several months. Alcoholic beverages to excess.	Probable carcinoma of larynx. Ulcerating mass involving epiglottic fold and fixation, right side larynx.	Biopsy larynx and radical lymph node.	Squamous cell carcinoma.	Died after 4 mo. hospitalization.
20	M	61	Recurrent hoarseness, 2 yr. Difficulty in swallowing and dysphagia and dyspnea, 2-3 mo. 20 lb. weight loss.	Mediastinal tumor with metastasis and tracheal obstruction or carcinoma of larynx.	Biopsy of larynx. Radical laryngectomy.	Squamous cell carcinoma. Metastatic epithelioma of thyroid.	Patient alive, no recurrence, 10 yr. after laryngectomy.
21	M	47	Hoarseness, 1 yr., gradually progressing. Increasing dyspnea. Had tuberculosis and had been in bed 6 mo.	Carcinoma of larynx. Swollen arytenoids partially obstructing vocal cord.	Biopsy, tracheotomy, X-ray.	Moderately well differentiated squamous cell carcinoma.	Died at home 4 mo. later.
22	M	65	Pain in throat, 7 mo. Lump on neck, 6 mo. 3 increasing hoarseness and dyspnea for week or so. 23 lb. weight loss. Used alcohol and tobacco excessively.	Advanced carcinoma of larynx.	Laryngoscopy and biopsy, X-ray.	Moderately well differentiated squamous cell carcinoma of pyriform sinus with extension to trachea, esophagus and cervical lymph nodes.	Died after 3 mo. hospitalization.
23	M	43	Dyspnea, difficulty in swallowing, and hoarseness, 1 yr.	Carcinoma of larynx with regional lymph node involvement.	Biopsy, tracheotomy, implantation of radium; X-ray therapy.	Hyperkeratosis and chronic inflammation. (Clinically malignant.)	Died after 3 mo. hospitalization.
24	M	55	Dyspnea and hoarseness, 15 mo. Swelling of neck, 7 mo., and dysphagia, 2 mo. Considerable weight loss. Uses tobacco excessively and alcohol. Had several X-ray treatments elsewhere before admission.	Extensive tumor invading larynx with extension to thyroid and metastasis to right posterior cervical lymph nodes.	None. Patient's condition did not warrant tracheotomy.	Postmortem: Ulceration and necrosis of larynx.	Died day following admission.
25	M	47	Pain in throat. Had had laryngectomy elsewhere 4 mo. before. Lost much weight, and pain in throat and chest increased since.	Postoperative carcinoma of larynx with metastasis.	None.	Purulent necrosis about neck incision. Metastatic squamous carcinoma, neck and chest.	Died 20 days after admission.
26	M	54	Swelling in left cheek, 5 mo. Nodules under left angle of mandible. Swelling whole left side of face to eye level. Had radium implantation elsewhere for "epithelioma of larynx."	Tumor of pharynx.	Resection cervical nerves for relief of pain.	Carcinoma of larynx.	Died after 7½ wk. in hospital.

27	M	68	Difficulty in swallowing, 3½ mo. Hoarseness and voice change, steadily progressing. Recently severe dysphagia. Weight loss, 25 lb. Tobacco pipe cancer. Cervical nodes palpable. Protrusion of vocal cords and stenosis of larynx.	Carcinoma of larynx with extension to surrounding areas.	Biopsy.	Anaplastic squamous cell carcinoma.	Died 5 days after admission.
28	M	54	Hoarseness, 3 mo. Dysphagia, hemoptysis for few weeks. Considerable weight loss. Neoplasm involving base of tongue, rt. tonsil, soft palate, pyriform sinus, larynx and rt. cervical nodes.	Carcinoma of larynx with extension.	None.	Postmortem: Carcinoma of pharynx, with secondary carcinoma of larynx.	Died 7 days after admission.
29	M	43	2 yr., 2 mo. before was in another hospital with sore throat and hoarseness. Diagnosis cancer made there. No progression for 1 yr. Larynx obstructed 2 yr. after diagnosis and death occurred in hospital. Patient heavy drinker, old luetic and morphine addict. Admitted for treatment in psychopathic ward.	Carcinoma of larynx; drug addiction.	Symptomatic treatment and morphine.	Autopsy refused.	Died 4 wk. after admission.
30	M	51	Patient admitted in moribund state with obstruction of breathing. Had seen a physician 3 wk. before, who made diagnosis of tuberculosis.	Probably pulmonary tuberculosis with laryngeal involvement.	Emergency tracheotomy.	Postmortem: Well differentiated squamous cell carcinoma of larynx.	Died 2 days after admission.
31	M	58	Throat trouble: lump, dysphagia and hoarseness, 4 wk. No weight loss. Worked until admission.	Malignancy of neck. Tumor right side below sternocleidomastoid muscle, about 2.5 cm. in diameter.	Laryngoscopy.	Carcinoma of larynx with metastasis to lymph nodes.	Died 9 days after admission.
32	M	49	Sore throat, hoarseness and cough, 5 mo. Weight loss, 8 lb. Cancer diagnosed elsewhere after biopsy.	Carcinoma of larynx.	Tracheotomy; laryngectomy.	Carcinoma of larynx.	Patient alive and well 3 yrs. after operation. No further follow up.
33	M	53	Difficult breathing and inability to swallow food, 6 mo. before. Also hoarseness. Lump, left side neck, 2 wk. Weight loss, 40 lb. in 6 mo.	Carcinoma whole left side larynx with metastasis and marked laryngeal obstruction.	Tracheotomy.	Postmortem: Carcinoma, larynx, with metastasis to left cervical node.	Died on day of admission.
34	M	35	Dyspnea, 8 mo. Hoarseness, 4 mo.	Carcinoma of larynx.	Tracheotomy.	Postmortem: Epithelioma, larynx; fibrosing tuberculosis tracheobronchial lymph nodes.	Died 4 days after admission.
35	M	56	Aphonia, 2 wk. Dysphagia, 2 mo. Dyspnea, 6 wk. Weight loss, 44 lb. in 6 mo. Firm tumor mass anterior to larynx in neck.	Carcinoma of larynx.			Died 2 days after admission.

(Continued)

Cleveland City Hospital. CARCINOMA OF THE LARYNX—(Continued).

No.	Sex	Age	Symptoms and Duration	Clinical Diagnosis	Treatment	Pathologic Diagnosis	Outcome
36	M	66	Dysphagia and dyspnea, 1 wk. Cough and hoarseness, 2 mo.	Tumor of the larynx.	Biopsy. X-rays, 2,000 c. Tracheotomy. Janeway gastrostomy.	Poorly differentiated squamous cell carcinoma of larynx.	Died 2 yr. after first seen.
37	M	62	Colored, had tuberculosis, bronchopneumonia and lung abscess. Aryepiglottic folds infiltrated and thickened. Laryngeal exam. difficult.	Tuberculous laryngitis.		Postmortem: Ulcerated, well differentiated squamous cell carcinoma, larynx, extension to thyroid cartilage through subcutaneous tissues.	Died of septicemia 8 mo. after first seen.
38	M	68	Difficulty in breathing, 4 wk. Some cough and dysphagia. No loss of wt.	Tracheal obstruction.	Emergency tracheotomy. Direct laryngoscopy and biopsy. X-rays, 3,150 r.	Well differentiated squamous carcinoma of larynx.	Died 9 days after admission.
39	M	65	Sore throat 4 mo. Hoarseness and difficulty in swallowing extending to right ear. Weight loss, 25-30 lb. 3 mo. Lesion in throat extending from right pyriform sinus to epiglottis, almost occluding glottis.	Carcinoma of larynx.			Died 2 wk. after admission from severe hemorrhage.
40	M	65	Dysphagia and cough. Diagnosis of carcinoma of larynx made 1 yr., 5 mo. previously. Had had radium implant for 1 yr. Ulcer with necrotic base. Hoarseness and stridor. False cords edematous, almost concealing true cords.	Carcinoma of larynx.	Laryngoscopy and biopsy; X-rays and radium implant.	Carcinoma right arytenoid; extension of carcinoma of tonsil.	Readmitted 4 mo. later in terminal condition. Discharged to nursing home.
41	M	64	Bleeding from throat. Had had laryngectomy 2½ yr. earlier, at another hospital. Had metastases to cervical lymph nodes and had radium implant 1½ yr. earlier. Also X-rays. Tracheotomy had been performed previously.	Carcinoma of larynx.		Squamous cell carcinoma.	Died after 2 mo. in hospital. Lived 2 yr., 3 mo. after laryngectomy.
42	M	60	Inability to swallow and hoarseness, 3 mo. Difficulty in swallowing cold food, 1 yr. Wide mass in region of larynx, 6 cm. diameter, nontender and only slightly tender to palpation.	Carcinoma of larynx.	Emergency tracheotomy.	Postmortem: Well differentiated squamous carcinoma of larynx with necrosis and ulceration of trachea and partially of esophagus.	Died after 2 mo. hospitalization.

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			Ulcerating carcinoma of larynx.	Laryngoscopy and biopsy; condition too advanced for surgery.	Poorly differentiated squamous cell carcinoma, epimoid area anterior commissure.	No follow up.
43	M	52	Tickling sensation in throat, and cough, 1 yr. Now complains of lump in throat, hoarseness, and loss of voice. Another physician told him he had tumor of throat and administered X-ray treatments. Weight loss, 40 lb. Difficulty in breathing, 1 day.			
44	M	49	Admitted with respiratory obstruction. Had been treated for years for laryngeal obstruction; previous biopsy had shown nonmalignant inflammatory tumor. Present attack more severe than similar previous acute attacks.	Laryngoscopy and biopsy. Tracheotomy. X-ray.	Carcinoma simplex.	Died 9 mo. later, after re-admission.
45	M	54	Pain in neck, earache and shortness of breath, 1 yr. Hoarseness, cough and dyspnea, 3 mo. Had had X-ray treatment which increased pain.	Biopsy.	Well differentiated squamous cell carcinoma.	Died after 3 wk. hospitalization.
46	M	58	Hoarseness, 10 mo. Had had "cancer" for years. Weight loss, 15 lb. Tumor in left arytenoid area.	Biopsy; X-ray.	Well differentiated squamous cell carcinoma of larynx.	Downward course; died after 6 wk. in hospital.
47	M	59	Paralysis left vocal cord, 6 yr. Pain and cough, 6 mo. Also difficulty in swallowing. Chronic alcoholic.		Squamous cell carcinoma of larynx, well differentiated.	Death from pneumonia 3 days after admission.
48	M	54	Symptoms of pneumonia. Productive cough and progressive hoarseness, 6 mo. No dysphagia and only occasional sore throat. False cords, edematous, almost thickening. Referred to hospital. Thickening of left true cord, 2 small firm nodules in neck near larynx.	Biopsy; laryngofissure, hemilaryngectomy; tracheotomy.	Poorly differentiated squamous cell carcinoma of larynx, basal cell characteristics.	Readmitted 3 mo. later with cough and difficulty in breathing. Died after 1 mo. in hospital.
49	M	49	Inability to swallow, 2 wk. Cannot talk because of hoarseness. Lump, rt. side of neck, 4.5 cm.	Laryngoscopy and biopsy.	Well differentiated squamous cell carcinoma.	Refused operation and was released 3 days after admission.
50	M	59	Difficulty in swallowing and slight pain in throat, 3 mo. Failure of voice, few wk. Difficulty in breathing and cyanosis day of admission.	Emergency tracheotomy.	Well differentiated squamous cell carcinoma of larynx.	Died 5 mo. later.
51	M	65	Hoarseness, 7 mo.	Laryngofissure; X-ray; radium implantation; tracheotomy; gastrostomy.	Squamous cell carcinoma of larynx.	Death 3 days after gastrostomy.

(Continued)

## Cleveland City Hospital CARCINOMA OF THE LARYNX—(Continued).

No.	Sex	Age	Symptoms and Duration	Clinical Diagnosis	Treatment	Pathologic Diagnosis	Outcome
52	M	66	Labored breathing.	Carcinoma of larynx with partial obstruction.	Emergency tracheotomy; ceased breathing during operation, artificial respiration no avail.	Poorly differentiated squamous cell carcinoma of larynx.	Death during tracheotomy.
53	M	73	Hoarseness and difficulty in swallowing, 8 mo.	Carcinoma of larynx.	Biopsy; X-rays.	Carcinoma left pyriform sinus.	Death after 20 days in hospital.
54	M	65	Progressive hoarseness, 6 mo.	Tumor left vocal cord, ulcerated.	Biopsy; total laryngectomy; X-rays.	Well differentiated squamous cell carcinoma of larynx.	Followed 6 mo.; no recurrence.
55	M	74	Hoarseness and dysphagia, 3 mo.	Carcinoma of larynx.	Biopsy; X-rays.	Well differentiated carcinoma of right true and false cords.	Patient alive but in very poor condition 20 mo. later.
56	M	56	Burning pain in throat, 1 yr. gradually increasing; difficulty in swallowing.	Tumor of arytenoid, probably cancer.	Laryngoscopy and biopsy.	Well differentiated squamous cell carcinoma of larynx.	Condition fair; prognosis poor on discharge. No follow up.
57	M	57	Hoarseness and sense of tightness in neck, 4 mo. Dysphagia and loss of weight. Enlarged gland in neck; firm, freely movable superficial lymph node just anterior to midportion of sternocleidomastoid muscle, 2.5x3 cm.	Cancer of larynx with metastasis to cervical lymph nodes.	Biopsy.	Carcinoma simplex of larynx with ulceration and partial obstruction of larynx and metastasis to cervical lymph nodes.	Patient also had chronic tuberculosis of lungs. Developed breathing difficulty following biopsy and died that evening.
58	M	58	Hoarseness, 7 wk.	Carcinoma of larynx; tremendous enlargement of epiglottis and encroachment of tumor mass on right side. Probable metastasis.	Biopsy; fulguration and tracheotomy; radium implantation; X-ray.	Squamous cell carcinoma.	Progressive loss of weight and appetite. Died 5 mo. after first admission.
59	M	48	Hoarseness, 3 yr., much worse for 1 mo. At admission, complete loss of voice. Difficulty in swallowing, but no pain. Lobulated growth on anterior of right vocal cord.	Tumor of larynx apparently confined to right vocal cord.	Laryngoscopy and biopsy; tracheotomy; removal right vocal cord.	Well differentiated squamous cell carcinoma.	Patient well with no evidence of disease in larynx or lymph nodes. Working steadily.
60	M	58	Sore throat, 3 wk. 1 mo. later, mass in throat.	Neoplasm of larynx.	Laryngoscopy and biopsy; X-rays.	Squamous cell carcinoma of larynx.	Died 7 mo. later at another hospital.

61	M	51	Hoarseness, 10 mo. Intermittent pain in neck, radiating up behind ears, 2 mo. Some lymph glands palpable in neck.	Carcinoma of larynx with metastasis to regional lymph nodes.	Biopsy. Laryngectomy refused. X-rays. Tracheotomy.	No neoplasia in 1st biopsy. Second showed highly differentiated squamous carcinoma.	Died 15 mo. after first admission; had progressive difficulty in swallowing.
62	M	57	Hoarseness, 2 mo. No pain, dysphagia or dyspnea.	Tumor of larynx.	Biopsy; removal of polyp of larynx; later, biopsy.	1. Inflammation with questionable malignancy. 2. Squamous cell carcinoma, well differentiated.	Died at home 8 mo. later.
63	M	57	Sore throat, 9 mo. Swelling, left side neck, 10 days. Hoarseness and progressive difficulty in swallowing.	Extrinsic laryngeal carcinoma.	Biopsy; X-rays; tracheotomy.	Well differentiated squamous cell carcinoma of larynx.	Progressive downward course; died 2 mo. after first admission.
64	M	67	Hoarseness.	Tumor of larynx.	Laryngectomy.	Well differentiated squamous cell carcinoma of larynx.	Patient alive, no evidence of recurrence 2 yr. after laryngectomy.
65	M	67	Lump on neck, dyspnea and swelling of legs.	Metastatic carcinoma right side of neck.	Excision cervical node and radium implantation.	Squamous carcinoma, right pyriform sinus; carcinoma simplex in lymph node.	Pulmonary metastasis; died 1 mo. after discharge from hospital.
66	M	61	Hoarseness, 1½ yr.; with intermittent aphonia. Tickling sensation in throat with dry cough, 25 yr.	Carcinoma of larynx.	Laryngectomy.	Squamous cell carcinoma of larynx.	Morphine addict 3 yr. before laryngectomy. Alive, no recurrence 4 yr. after operation.
67	M	57	Swelling, right side of neck, 3 wk. Difficulty in breathing; occasional sharp pain in neck and right ear.	Carcinoma of larynx.	Biopsy; tracheotomy; X-rays.	Squamous cell carcinoma of larynx, with metastasis to regional lymph nodes, lungs, liver, pleura and ribs.	Died after 7 mo. in hospital.
68	M	56	Colored. Hoarseness, 14-15 mo.	Sessile growth on left vocal cord.	Biopsy; laryngectomy.	Well differentiated squamous cell carcinoma.	Alive, no evidence disease in throat 1½ yr. after operation.
69	M	64	Cough, dysphagia, lump in neck. Weight loss.		Biopsy; tracheotomy; X-rays, radium.	Moderately well differentiated squamous cell carcinoma of larynx.	Died after 3 mo. in hospital.
70	M	45	Pain in throat and right ear, 1 yr. Operation at out-of-town hospital 4 mo. earlier. Severe pain again, 2 wk. Weight loss, 25 lb. Dysphagia.	Advanced carcinoma of larynx.	Biopsy.	Moderately well differentiated squamous cell carcinoma.	In hospital 4 mo. Died 5 mo. after discharge.
Lakeside Hospital.							
71	M	45	Hoarseness, 3 yr., worse last 3 mo. Difficulty in swallowing, and some dyspnea. Pain radiating to ear on right. Weight loss, 20 lb. 15 yr. before had injury to larynx from blow on neck.	Large mass, left side of larynx, obstructing true cord.	Biopsy.	Poorly differentiated squamous cell carcinoma of larynx.	No follow up.

(Continued)

## Cleveland City Hospital. CARCINOMA OF THE LARYNX—(Continued).

No.	Sex	Age	Symptoms and Duration	Clinical Diagnosis	Treatment	Pathologic Diagnosis	Outcome
72	M	64	Weakness of voice, 10 yr., more marked for 6 yr. Severe hoarseness for 6 yr. before has become progressively worse.	Redness and swelling involving subglottic areas, hoarseness, more marked on left.	Laryngoscopy and biopsy.	Well differentiated squamous cell carcinoma, seat of inflammation, and chronic inflammation.	No follow up.
73	M	49	Hoarseness and sore throat, 3 mo. Loss of appetite and chronic cough. Considerable dysphagia. Weight loss, 19 lb. No hemoptysis.	Carcinoma of larynx.	Total laryngectomy.	Carcinoma of larynx, intrinsic squamous type.	Left hospital in good condition. No follow up.
74	M	70	Hoarseness, 2 yr. Difficulty in swallowing, 3 mo. Severe sore throat, 2 mo. Pain left side jaw and left upper cervical region, 1 wk. No loss of weight.	Large mass in left ary-epiglottic fold extending over entrance of larynx, obstructing vision of vocal cords.	Tracheotomy; X-ray therapy; biopsy.	Well differentiated squamous cell carcinoma of larynx.	Was alive 6 mo. later but did not return for follow up examination, as requested.
75	M	78	Sore throat, 2 yr., worse last 5-6 mo. Pain on swallowing, 3 mo. Occasional pain, right ear. Hoarseness, 3 wk. Some loss of weight.	Tumor of larynx.	Biopsy; X-rays; tracheotomy.	Moderately well differentiated squamous cell carcinoma.	Died 11 mo. after first admission, after progressive downward course.
76	M	49	Hoarseness, 2 mo., after sore throat. Difficulty in swallowing, 3 wk. Some difficulty in breathing, 1 wk. Weight loss. No palpable lymph nodes in neck.	Tumor of larynx.	Biopsy; tracheotomy; X-rays (3,500 r to 2 cervical fields); gastrostomy, 1 mo. later.	Poorly differentiated squamous cell carcinoma of vocal cord.	Died following gastrostomy.
77	M	31	Hoarseness, 3 mo., most marked in late afternoon; worse past month.	Tumor right vocal cord, extending almost to anterior commissure.	Laryngoscopy and biopsy.	Well differentiated squamous cell carcinoma of vocal cord.	Discharged in good condition. No follow up.
78	M	65	Nonpainful lump, rt. side neck, 7 wk. Varied in size but has enlarged progressively.	Tumor of larynx with cervical metastasis.	Biopsy; X-rays.	First biopsy did not show malignancy. 2nd: carcinoma simplex of larynx.	Alive 6 mo. later; no follow up examination.
79	M	49	Respiratory difficulties. Redness and edema of false cord and arytenoid. Weight loss, 22 lb.	Carcinoma of larynx.	Tracheotomy; X-rays.	Squamous cell carcinoma, left pyriform sinus of larynx.	Admitted 5 times in next 2 mo., with peritracical abscess, finally metastasis, lungs; death 5 mo.
80	M	49	Slight hoarseness and difficulty in swallowing, 3 wk. Severe pain, 1 wk. Ulcerated mass, 1.5 cm., in right pyriform sinus.	Deferred.	Laryngoscopy and biopsy; X-rays.	Poorly differentiated squamous cell carcinoma of larynx.	Developed dyspnea; admitted 4 times; dysphagia; severe alcoholism; psychosis. Lost to follow up.



81	M	53	Sore throat, 2 mo. Hoarseness, 2 wk. Some difficulty in swallowing. Occasional attacks of dyspnea. Large tumor on left side of epiglottis and epiglottic fold. Cervical lymph node.	Carcinoma of the pharynx with extension into larynx.	Biopsy; incision and drainage abscess neck; tracheotomy; gastrostomy.	Well differentiated squamous cell carcinoma seat of acute and chronic inflammation (pharynx and larynx).	Patient died in hospital 3 mo. after second admission.
82	F	65	Hoarseness, 2½ yr. Had had papilloma of larynx removed 3 times previously.	Papilloma of larynx.	Papilloma removed, left vocal cord, 3 times. Laryngectomy after last biopsy showed malignancy.	Papilloma of larynx (3 times). 4th biopsy showed squamous cell carcinoma, moderately well differentiated.	Diagnosis of carcinoma made 7 mo. after 1st admission. No follow up record.
83	M	68	Diagnosis of carcinoma of larynx had been made elsewhere and patient had received 3 courses of radium. Hoarseness, 3 yr. Difficulty in swallowing had developed into complete inability 3 days before. Increasing cough, 3 wk.	Carcinoma of larynx with metastasis to cervical lymph nodes.	Gastrostomy.	Carcinoma simplex of larynx with cervical metastases.	Discharged improved 1 mo. after gastrostomy (Feb./6/42). No further follow up.
84	M	45	Hoarseness, more than 1 yr., gradual onset.	Papilloma of vocal cord.	Laryngoscopy and removal of vocal cord.	Fibroma of left vocal cord.	Voice much improved on discharge.
85	M	39	Under treatment for tuberculosis of lungs.	Granuloma of right true cord, probably tuberculous.	Biopsy.	Fibroma of larynx with metaplasia of mucosa.	Patient transferred to private hospital for treatment.
86	M	42	Hoarseness, 3-4 wk.	Sessile tumor in posterior commissure of larynx. Papilloma of larynx.	None.	Laryngeal polyp.	
87	F	36	Admitted 8 days postpartum with lobar pneumonia. Incidental finding of papilloma of larynx.	Polyp of vocal cord.	None.	No definite diagnosis.	Dismissed in good condition.
88	M	23	Hoarseness, 5 yr., gradually increasing. Continuous hoarseness, 2 yr. Frequently unable to speak at all.	Laryngeal polyp, right cord near anterior commissure.	Laryngoscopy and removal of fibroma. Polypectomy.	Stratified squamous mucosa the seat of chronic inflammation with diagnosis of benign papilloma of larynx. No evidence of tuberculosis.	Sent to tuberculosis sanitarium.
89	M	43	Had been treated for pulmonary tuberculosis. Hoarseness, several mo.				

(Continued)

## Lakeside Hospital. BENIGN TUMORS OF THE LARYNX.

No.	Sex	Age	Symptoms and Duration	Clinical Diagnosis	Treatment	Pathologic Diagnosis	Outcome
90	M	36	Difficulty in swallowing and pain in throat. Growth in throat, 2 yr.	Tumor pharynx, right. Mass 2.5x2 cm. in left aryepiglottic fold.	Tumor removed through laryngoscope.	Fibroma hemangiectaticum.	No follow up.
91	M	4	Hypertrophic tonsils and adenoids. Difficulty in swallowing. Breathes through the mouth.	Fibroma of larynx; "single" nodes.	Removal tonsils and adenoids.		Discharged in 24 hours.
92	F	30	Dyspnea on exertion; hoarseness, 3 mo.	Chronic laryngitis.	Laryngoscopy and biopsy.	Fibroma of larynx with hyperplasia of mucosa. Amyloid not excluded.	
93	M	36	Colored. Intermittent hoarseness, about 1 yr.	Papilloma of larynx.	Laryngoscopy and excision papilloma left vocal cord.	Hyalinization of mucosal connective tissue.	
94	F	8	Hoarseness and difficulty in respiration. Had had papilloma removed 11 times before. Recurrence in 3 mo. Symptoms much worse last 3 wk.	Large pedunculated papilloma of anterior commissure of larynx.	Removal multiple papillomata of vocal cords.	Squamous cell papilloma of larynx.	Discharged following day to private physician.
95	M	61	Hoarseness, 2 yr., more severe last 2 mo. No difficulty in breathing or cough.	Papilloma of larynx.	Laryngoscopy and removal of polyp.	Benign polyp, seat of slight chronic inflammation.	
96	F	3½	Difficulty in breathing. Hoarseness since birth. Increased hoarseness and noisy respiration, 1 mo. Pneumonia, 18 mo. previously.	Papilloma of larynx.	Direct laryngoscopy and removal of papilloma.	Squamous cell papilloma of larynx.	
97	M	58	Hoarseness, 3 wk. No pain or difficulty in swallowing or breathing.	Papillomatous mass on left vocal cord.	Excision and direct laryngoscopy.	Papilloma of larynx.	No follow up.
98	M	36	Hoarseness, 9 mo.	Papilloma.	Removal of papilloma.	Squamous cell papilloma of larynx.	Death from cerebral accident 6 mo. later.
99	F	42	Hoarseness, 11 mo., following pneumonia, progressively more severe. Cough, 5 mo., severe last 5 days.	Tumor anterior commissure and left vocal cord.	Laryngoscopy and removal of papilloma.	Squamous cell papilloma, no evidence of malignant change.	No follow up.
100	M	5	Difficulty in breathing and hoarseness, 2 yr. Much worse past 2 wk.	Papilloma of vocal cords.	Removal papillomata through laryngoscope; dyspareunia delivered immediately.	Squamous cell papilloma of larynx.	Discharged in 48 hours.
101	M	29	Hoarseness for 2 yr.	Papilloma of larynx.	Removal laryngeal nodule.		

102	M	78	Admitted as emergency because of obstruction to breathing. Had tracheotomy at another hospital 3 mo. before for same difficulty.	Fibroma of larynx.	None.		Died 3 hours after admission.
103	M	55	Hoarseness, 1 mo. 4 or 5 previous attacks 6 yr. earlier. Dyspnea on exertion, 1 yr. Weight loss, 40 lb. from diet for blood pressure.	Mass protruding between vocal cords at anterior commissure.	Biopsy. Attempted removal unsuccessful.	Adenomatous cellular fibroma; sarcoma cannot be definitely excluded.	No follow up.
104	F	9	Hoarseness. Not able to speak above whisper, 1½ yr. Papilloma of larynx removed 5 yr. before.	Papilloma of larynx.	Removal papilloma 5 times, 1924-1936. Radiation on one admission.	Papilloma of larynx.	Was 21 at last admission; discharged in good condition. Hoarseness persists.
105	F	3	Hoarseness developing after cold, 1 yr. before. Later, difficulty in breathing.	Multiple papillomata of larynx.	Laryngoscopy and removal of multiple papillomata of larynx.	Squamous cell papilloma.	Admitted 6 times later with recurrence of papilloma each time. Hoarseness had persisted and respiratory difficulty progressively worse. Improvement for time and readmitted with recurrence of symptoms and tumor. Last admission 12/3/41.

## CONCLUSION.

The results in this series of cases, so far as actual cures of carcinoma are concerned, are somewhat discouraging, and I should like to report that many more patients had been subjected to laryngeal operations and had survived for five to 10-year periods. That only 15 patients of 83 with carcinoma were in a condition to warrant laryngeal operation shows that the results do not depend primarily on improvements in surgical and radiologic technique. Until the patient is seen in time to benefit from these improvements, the general results of treatment of cancer of the larynx will not markedly improve.

Since this is a problem which is of paramount concern to the specialists in otolaryngology, perhaps they, as a group, should initiate steps to improve the situation. The public must be educated that laryngeal cancer is curable, and that many patients are able to develop a pseudo-voice, so that persons with this disease will seek treatment in the early stages. Above all, the importance of persistent hoarseness should be stressed, since this is the first symptom in almost all cases of cancer of the larynx.

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AMERICAN BOARD OF OTOLARYNGOLOGY.

The next examination of the American Board of Otolaryngology will be held in Chicago at the Palmer House on Oct. 6-7-8-9, 1943.

## BURNS OF THE EAR, NOSE, MOUTH AND ADJACENT TISSUES.\*

DR. ARCHIE EDWARD CRUTHIRDS, Phoenix.

Mechanized warfare accompanied by an intensive step-up in the tempo of industrial preparation provides rather startling confirmation of the statement by Harkins<sup>1</sup> to the effect that "burns represent the greatest therapeutic problem in the field of fatal accidents." The high incidence of burns about the face has been emphasized, particularly in relation to war burns and burns occurring in war industries.

The liability to burn injuries was illustrated by a compilation of casualties Dec. 7, 1941, at Pearl Harbor when burns accounted for 60 per cent of the total. Of these burns the major portion included injury to the ears, nose, mouth and adjacent tissues.

Here, then, is a problem of rapidly increasing importance to the otolaryngologist, although, heretofore, he has not had to be particularly concerned about it. The traumatic surgeon trained in dealing with burn injuries recognizes the necessity of consulting with specialists in the field of otolaryngology, so it is vital for the otolaryngologist to understand more of the problem that confronts the traumatic surgeon.

With the increasing demand on the medical profession to minister to a constantly growing volume of emergency civilian as well as war needs, there is every indication that the burden on all specialists will gradually become heavier.

In a report on the etiology and prognosis of burns and scalds, Hoffman<sup>2</sup> reported the location of burns on the face in 45 per cent of a total of 1,000 cases. I recently made a survey of burn cases. A questionnaire was sent out to 1,800 industrial surgeons covering the larger industrial companies. This survey, although far from complete, involved 25,000 cases; burns about the ear, nose, mouth and adjacent tissues

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accounted for 30 per cent of the total number of burn cases. Being unprotected, the face is more exposed to burns than any other portion of the body.

According to Berkow's formula, a burn involving one-third of the head would be computed as covering but 2 per cent of the body area; yet a serious face burn can easily be an injury of major importance.

The early attendance of the otolaryngologist in the treatment of burns involving the ears, nose, mouth and adjacent tissue cannot be too strongly emphasized, for the final outcome in the majority of cases will depend upon management of local treatment and production of desired cosmetic results with proper preparation of injured areas for plastic surgery where necessary.

#### SHOCK.

Of two lines of treatment required in the management of burn injuries, we have: First, the general treatment including that for shock; second, local treatment of the burned area. The first is generally regarded as the most important. Ordinarily the extent of shock can be measured by the extent of body area involved, but it is understandable why this might not hold in the case of serious face burns. Although the area involved may be minor, the resultant shock is frequently disproportionate. Here again, however, the speed and efficacy with which the local treatment is applied can have a bearing on the cosmetic results.

Harkins<sup>3</sup> divides the treatment of shock under four heads: Supportive Measures, Oxygen, Adrenal Cortex, Plasma and other fluids.

From the standpoint of local treatment the sulfhydryl-yielding solution\* employed by the author offers many advantages. It provides stimulus to epithelial proliferation, it has demonstrated a capacity to prevent or abate infection. It is non-toxic and when employed as a spray a protective eschar can safely be formed on the face. It can also be applied in wet compresses and is economical to use.

In applying this sulfhydryl solution the method of choice is the spray, diluted 1:1 in water, and applied every 30 min-

\*Marketed by E. C. Lientz and Co., Inc., 1006 West Sixth Street, Los Angeles, Cal., under the trade-name of Hydrosulphosol. See their advertisement on page 3 of this issue.



utes to one hour until a satisfactory eschar is established. Generally only one or two spray applications are required to establish such an eschar.

Additional spraying may be made every two hours the first two or three days, with only one or two applications daily thereafter until healing is complete, or as progress indicates. For old burns a 1:3 dilution has been found advisable, particularly in the beginning.

Wet compresses employing a 1:1 dilution applied for 15 to 20 minutes once every two hours can be used at the start of treatment and tapered off as progress indicates. If initial application of wet compresses causes painful reaction the dilution can be increased to provide tolerance. Dilutions up to 1:20 have been used successfully in such compresses, particularly for old burns which are likely to react painfully.

In reporting on laboratory and clinical research studies conducted on this sulfhydryl solution at the Institute of Pathology, The Western Pennsylvania Hospital, Pittsburgh, Mellon<sup>4</sup> concludes that: "In the cases so far studied, this solution appears to fulfill the several requisites of a successful local treatment of burns more completely than any other single treatment with which we have been familiar."

On account of their scarring tendency, methods of treatment commonly employed on burns on other parts of the body, such as tannic acid for example, are not to be recommended for the local treatment of burns about the ears, nose, mouth and adjacent tissue.

#### RELIEF OF PAIN.

In all burn cases treated by me with the 1:1 Hydrosulphosol spray, pain has been almost instantly relieved and continued to be controlled. Where additional aid is deemed necessary to relieve pain preference is given to agents that do not interfere with kidney function or that are indicated for obvious reasons with consideration of possible complications characteristic of this type of injury.

#### SULFUR METABOLISM.

While the authoritative character of the laboratory and clinical research work conducted on sulfhydryl provides ade-

quate background for its adoption as a reliable and probably superior method of treating burns, a practical consideration of sulfur metabolism alone would warrant a study of this nature.

Frequent reference is made to the fact that 60 per cent of the body sulfur is contained in the skin. As a serious burn creates a sudden injury to the skin, and disturbance to sulfur equilibrium, it would seem logical to attempt to counteract such changes. Biochemical research has indicated the sulfhydryl radical as being an essential substance in the stimulation of epithelial proliferation.

A value for ordinary saline compresses in burn injuries has been reported by many workers. In this respect this sulfhydryl solution qualifies completely with a normal pH of 10 which, upon dilution, quickly reaches levels consonant with tissue function.<sup>5</sup>

The very serious nature of the problem of treating face burns has been impressed upon the author by the reports of others and by personal experience. With previously available medication and in spite of the exercise of utmost care and application of the best indicated therapy, chemical and caustic burns particularly were accompanied with long, painful and expensive periods of hospitalization. Upon recovery even the most expert plastic surgery frequently left much to be desired.

For many months prior to the spring of 1941, special study had been given to beneficial results reported by the use of the sulfhydryl solution. The work on this solution was pioneered by Dr. Ralph R. Mellon, Director of the Institute of Pathology, The Western Pennsylvania Hospital, Pittsburgh. This work was done in collaboration with the Mellon Institute of Industrial Research.

The chemistry of the solution as a source of sulfhydryl linkages was indicated by Mellon and his associates and the results of the initial controlled study published by McBroom.<sup>6</sup> Late in March, 1941, the problem of having to treat a severe lye burn injury involving the ears, nose, mouth and adjacent tissue was suddenly presented to the writer.

The treatment employed and results obtained are outlined herewith in Case 1. The corrosive action of the lye was evi-

dent by the time the patient reached the hospital after an elapse of some 90 minutes following the injury. A previous case of this nature treated by the author with other accepted medication was followed by more than two months' hospitalization and resulted in severe scarring.

The fact that the injuries caused by the lye in Case 1 cleared up in 10 days and the patient was fully recovered in



Fig. 1. Lye burn of the face.

three weeks without scarring, except for a small area around the right eye which had to be removed, was naturally most gratifying.

Shortly thereafter two cases involving serious burns about the face, caused by steam, were similarly treated. and one of these is submitted as Case 2 (see Figs. 4 to 7). It should be noted that its complete recovery without scarring within eight days is to be contrasted with an average of 18 days' hospital stay reported by Hoffman<sup>2</sup> in 305 burn cases caused by scalds. A similar average recovery period of 18 days or more,

for burns of equal severity and extent, has been reported where other previously acceptable medication was used. Moreover, in Case 2, as was also true for all cases reported here, there was no infection.

In Hoffman's series of 305 cases caused by hot liquid, 113 are reported as having developed infection. It might be added



Fig. 2. Same lye burn 10 days later.

that this percentage of infected cases has been reported as approximated by other workers using medication or methods different from that employed in the series here reported.

The use of sulphhydryl compounds for stimulation of epithelial proliferation has been previously reported by Reimann,<sup>7</sup> 1930, and Brunsting and Simonsen.<sup>8</sup>

Reimann used thiocresol and Brunsting used cysteine prepared from the hair of man. Apparently the cost or unavail-

ability of both sources of sulfhydryl prevented further use of wider application until the advent of Hydrosulphosol, which according to Salle and Korzenovsky<sup>9</sup> contains a concentration of sulfhydryl ion 50 times greater than human blood; also, it is in aqueous solution.

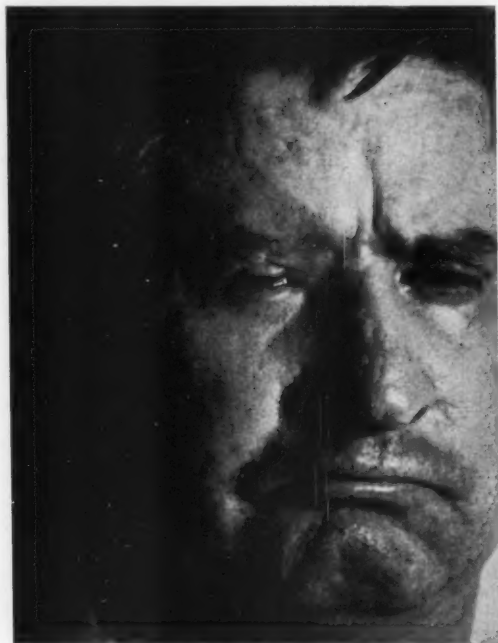


Fig. 3. Same lye burn one month later after treatment with Hydrosulphosol.

Direct information bearing on the absorption of sulfur in some form was furnished by Pierce, referred to by Dr. R. R. Mellon<sup>4</sup> in clinical estimations of the total output in the urine. The output determined in terms of  $\text{SO}_2$  was 9.3 gm. in the first 24 hours when the maximum application of Hydrosulphosol was made. The output during the second 24-hour period dropped to 7.92 gm., representing a comparative decrease in the amount of Hydrosulphosol applied locally. The normal output of  $\text{SO}_2$  varies between 1.5 and 3 gm., depending largely on the protein intake. In severe burns this

sulphydryl solution has been applied freely with indications of absorption but no evidence of toxicity.

#### GLUTATHIONE.

In 1921, Hopkins<sup>10</sup> isolated and identified a substance which he named "glutathione." Hopkins believed this compound



Fig. 4. Steam burn of face and body.

was composed of two amino acids, glutamic acid and cysteine bound together as a dipeptide by the usual linkage. This important material is referred to by Elvehjem and associates<sup>11</sup> as: "of almost universal occurrence in animal tissues

where the concentration roughly parallels the intensity of metabolic activity."

Hammett<sup>12</sup> provides the following explanation of the function of glutathione in developmental growth: "Thus, then, it

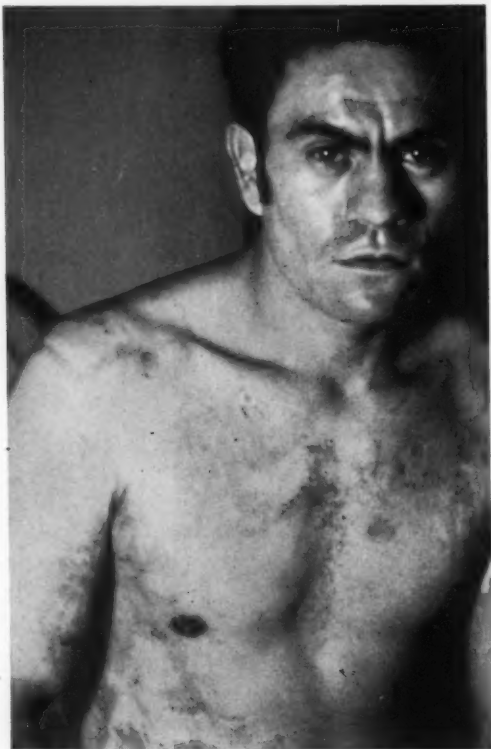


Fig. 5. Same steam burn eight days later after treatment with Hydrosulphosol.

seems as if in glutathione, nature has developed in one and the same chemical compound a complex which conditions if it does not determine the course of the several basic and essential processes concerned in developmental growth. Through cysteine it accelerates cell proliferation, the first step; through glycine it accelerates protein reconstitution which is an essential accompaniment to both cell division and cellular dif-



ferentiation; and through glutamic acid it accelerates the progress of that selective building-up of the protein molecule which is the characterizing process of differentiation and its consequent organization.

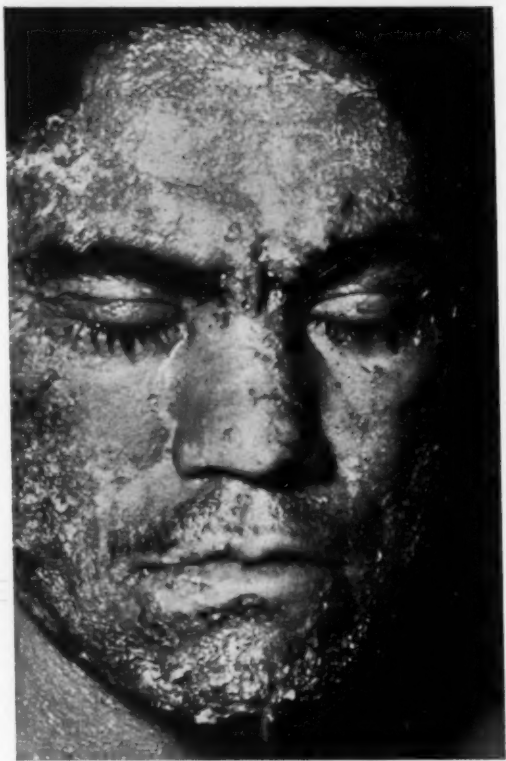


Fig. 6. Steam burn of face.

"There are those who deprecatingly insinuate that reports of what happens under certain conditions are of little value without explanations of the mechanism producing the given reaction. It takes but little clear thinking to realize that the first step in scientific inquiry is to find out what happens. Only when this has been done can there be found out how it happens."

Mellon<sup>4</sup> reports that tissue culture studies in his own laboratory on Hydrosulphosol have shown that: "Not only does normal growth occur, but in dilutions of 1:500 to 1:1,000 an important function of chick heart embryo fibroblasts under-

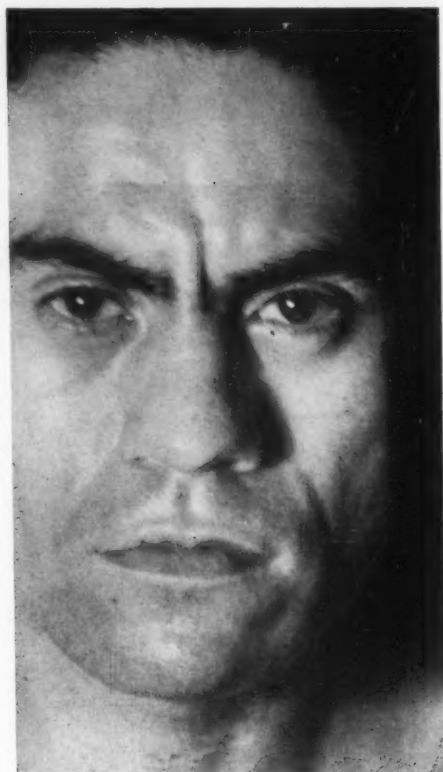


Fig. 7. Same steam burn eight days later after treatment with Hydrosulphosol.

goes marked stimulation. This function is the proteolytic one, whose differentiating, and, therefore, healing connotations align themselves with the clinical expressions in this connection. Functioning thus in relatively high dilutions suggests that the effect is an enzymatic one. Indeed, the -SH linkages are well known to function as coenzymes in certain respiratory systems, implementing cell nutrition."

## INFECTION.

The rôle played by infection in burn injuries suggests giving the utmost consideration to medication that prevents or abates this factor. The fact that reports of all burns treated to date by this sulfhydryl solution show they have healed without the intervention of infection would appear to present a remarkable record.

Pierce<sup>13</sup> reported a complete absence of infection when using this sulfhydryl yielding solution.

In a later series of some 70-odd cases Pierce<sup>14</sup> reported continued confirmation of this absence of infection in all cases treated with this sulfhydryl solution.

Moorhead<sup>15</sup> stated: "A burn is an infected wound produced by heat."

Harkins refers to two schools of thought: One, represented chiefly by Aldrich,<sup>16</sup> believes that infection is almost invariably present — and dangerous — after the first 24 to 48 hours in severe burns; the other, represented chiefly by Wilson,<sup>17</sup> believes that infection is not of much importance during the first week. In reporting on 1,000 burn cases Hoffman<sup>2</sup> noted infection in 333 patients. The importance of preventing or abating infection in burns involving the ear, nose, mouth and adjacent tissue is well recognized.

## SCAR TISSUE AND ITS RELATION TO HEALING TIME.

A complete lack of scarring or greatly reduced scarring noted in all cases treated to date with this sulfhydryl solution suggests an interesting study of this complication that is recognized as a potential danger in all burn injuries. This favorable result has been noted by others applying sulfhydryl compounds and appears to be definitely associated with the important factor of rapid healing.

Treves and Pack<sup>18</sup> point out that: "Chronic granulation tissue is the parent of scar tissue, and it might be added the longer the wound takes to heal the more the scar tissue."

The development of cancer in burn scars, reported by Treves and Packs, has been noted also by Johnson<sup>19</sup> and others.

The question of scar tissue, therefore, is not to be lightly dismissed as one bearing on cosmetic results only.

#### SULFHYDRYL COMPOUNDS IN PLASTIC SURGERY.

The application of Hydrosulphosol following plastic surgery has been made successfully by us with stimulation of healing as noted above. All such cases have healed without intervention of infection. In plastic surgery involving the ears, nose, mouth and adjacent tissues the following technique has been found successful: Apply 1:20 dilution of Hydrosulphosol in distilled water as wet compress directly on the operative field, 15 to 20 minutes, three times the first day, twice the second day and once daily for some five days. Pierce<sup>20</sup> used this sulfhydryl solution successfully on both the operative area and donor site in plastic surgery.

Brunsting<sup>8</sup> applied cysteine successfully in extensively denuded surfaces, such as occur in burns from gasoline.

Riley,<sup>21</sup> Resident Surgeon, Scottish Emergency Hospital Service, refers to the use of wet dressings employing sulfhydryl compounds following skin grafting. Comparison of results obtained following sulfhydryl therapy on plastic surgery indicated complete healing in from one-third to one-half the time noted in cases previously treated with other types of medication. All such cases healed without any infection and with improved cosmetic results.

#### SULFONAMIDES.

Numerous reports have been made of employing various members of the "sulfa" drug family in connection with the treatment of burns. A study of the literature would indicate the most value that could be expected from the application of these drugs would be to prevent or abate infection.

As the sulfhydryl solution employed by the author has adequately met the problem of infection and without producing toxic results and is known to stimulate proliferation of epithelium, resort has not been made to other medication during the development of the study here reported.

#### TANNING METHOD.

Reference to the tanning method of treating burns can well be confused with an assumed application of tannic acid,

whereas it is recognized that other tanning agents may well be superior to tannic acid.

Research on the value of employing warm, moist air therapy for burns by Smith, Risk and Beck<sup>22</sup> led to the conclusion by these workers that tannic acid does not possess any specific accelerative healing action.

In a well deserved tribute to his brilliant young colleague, Harkins<sup>1</sup> hails the contribution to burn therapy made by Edward Clark Davidson. As Harkins points out: "A study of Davidson's original works can only lead to the conclusion that he did not stumble upon his method blindly. He was engaged in combined clinical and investigative work in related fields and was able to plan just how to prove his conclusions."

The fact that tannic acid is today being assailed from many angles an undesirable or even dangerous method of treating burns does not detract from Davidson's contribution — the tanning method, as an important advance in modern therapeutics.

"Even if tannic acid is supplanted by some other form of application, the tanning principle seems destined to survive for some time at least," concludes Harkins.

Referring to treatment of face burns, Harkins says: "There is, however, little use in applying tannic acid to the face. The chief function of tannic acid is to prevent shock and possible toxemia and to keep the region clean by keeping it dry. It is thought by many that tannic acid may destroy small skin islands and may not give the ideal ultimate cosmetic results. If there is any place on the body where the cosmetic result is of importance that place is the face."

#### SUMMARY AND CONCLUSIONS.

Fifty cases involving burns of the ear, nose, mouth and adjacent tissues treated with a sulfhydryl-yielding solution produced prompt healing without intervention of clinically significant infection in any case and without evidence of drug toxicity.

The increasing incidence of burns involving the ear, nose, mouth and adjacent tissue warrants early attendance of the otolaryngologist.

Emphasis is placed on the choice of a method of treatment believed to hasten healing, inasmuch as rapid healing is usually associated with reduction of scarring or complete freedom from scar tissue.

Ability of medication used to prevent or abate infection eliminates completely, or reduces to a minimum, the need for debridement.

The pain of a burn lesion has been relieved by spraying the medicant alone, which required no addition of anesthetic or sedative. This experience suggests that much may be gained by disturbing the injured area as little as possible, through eliminating debridement or holding it to an absolute minimum.

Hydrosulphosol, a sulfhydryl solution, has been used successfully following plastic surgery with application on both the operative area and donor site.

It is believed to provide an important stimulant to epithelial proliferation and thus hasten healing.

#### CASE REPORTS.

*Case 1:* P. G., age 48, yard captain at the Arizona State Penitentiary, was guarding prisoners at a baseball game in the penitentiary grounds when one of the convicts hurled the contents of a quart jar containing three cans of commercial lye. On analysis the solution was found to be stronger than 40 per cent.

The lye solution burned the nose both inside and out, went into the mouth, cauterizing the anterior two-thirds of the tongue, inside the lips, including the corners of the mouth. It entered the right external auditory canal as well as the whole external right ear, both eyes and upper half of the neck and chin. The accident occurred at Florence, Ariz. Ninety minutes elapsed before the patient could be transported to the Good Samaritan Hospital at Phoenix, Ariz. Emergency treatment at the penitentiary consisted of washing the affected areas with a weak acetic acid. The corrosive action of the lye had caused a third degree burn on the skin of the right side of the nose, some of the conjunctiva and cornea of the right eye, also skin at the entrance of the right internal auditory meatus, as well as the lobe of the right ear. There were other areas of third degree burns on the left side of the nose, left lids, cheeks, forehead and neck.

In addition to general treatment directed to combating shock, control of pain, maintenance of fluid balance, the local treatment was as follows: The burned surface was sprayed with a solution containing one part of Hydrosulphosol and one part of distilled water every one or two hours; later increasing the interval between treatments. As soon as the first spraying was completed the intense pain was relieved; however, there was some stinging on first spraying of the solution. A hard rubber nose DeVilbiss atomizer was used for the spray. Full strength Hydrosulphosol

was used to spray the tongue, whereas a solution of 4 cc. of the Hydrosulphosol to 1 oz. of distilled water was used as drops to the eyes. No debridement was carried out. At no time was there any sign of infection of injured tissue. In later cases a 1:20 dilution in sterile distilled water was found satisfactory for drops in the eyes.

When the patient entered the hospital, temperature was 97°; a short peak of 106.2° was recorded the first day with an abrupt drop to normal during the first 24 hours. During the next five days temperature varied from 99° to 101°, after which it remained approximately normal.

During the first 24 hours blood showed as follows: red count, 5,430,000; white count, 19,400; hemoglobin, 15.5 gm.; polymorphonucleoleucocytes, 90 per cent; blood studies showed a gradual return to normal by the eighteenth day. Urinalysis showed no abnormal findings.

It was necessary to apply Hydrosulphosol cream to the corners of the mouth to prevent cracking of the mucous membrane; this was also applied to the inside of the nose and inside the right internal auditory canal. Gauze pledgets kept moist with half strength Hydrosulphosol were used inside the nose and also packed lightly into the right internal auditory canal.

At the end of 10 days the eschar separated easily and was removed, revealing fully repaired skin except for small areas around the right eye and corner of the mouth. The fact that this was a lye burn, much scarring was expected. This case healed more quickly than normal and showed very few scars.

*Case 2:* J. N., male (Mexican), age 27. While working near small steam boiler, the thermostat failed to work and the boiler exploded, burning the patient's face, neck and body. There were second degree burns about the ears, chin and right cheek, with first degree burns about the nose, lids and forehead; also second degree burns about the right shoulder and right side of the abdomen; patient was in severe pain when admitted to the hospital. Patient was at ease after spraying with Hydrosulphosol and distilled water, one part each. Hydrosulphosol cream was used just within the outer margin of the nose and outer edges of the external ear and around the outer orifice of the external auditory meatus. Small gauze wicks kept moist with the half strength solution were used just within the nose and ear during the first three or four days. The cream was also used at the angle of the lips.

Temperature showed initial rise of 101.8° but 12 hours later temperature was 99°, with a rise to 100° on the second day, then to normal; blood showed slight elevation of red cell and total white cell count; no debridement. Recovery very rapid, with no scarring; was discharged on eighth day (see Figs. 4, 5, 6 and 7).

Other cases with burn injuries about the ear, nose, mouth and adjacent tissues, numbering 45, were similarly treated with no infection and prompt healing indicated by no scarring or very little scarring. Several cases were seen after grease had been used. This was removed with as little shock as possible; the solution's strength was reduced one part in four in these cases as the initial spraying is painful; the second spraying can then be raised to equal parts of spray solution and distilled water, and finally if the eschar is not heavy enough, full strength can be used. Before spraying the solution on the face, the eyes are covered with oil silk to prevent the full strength solution from getting in the eyes, but should some get



in the eyes, there will be a stinging but no damage to the tissues.

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## A CASE OF FOREIGN BODY IN EACH LUNG.

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Numerous references are made in the literature to dental objects in the lung. They cover a variety of foreign bodies such as whole teeth or fragments, gold crowns, bridges, appliances to straighten teeth, partial plates, dental instruments and parts of dental instruments.

Clerf reported one case in which two teeth were aspirated in the right lung; there are also numerous references to vegetable foreign bodies being multiple in the lungs. Holinger reported multiple kernels of corn in both bronchi; Tucker, Orton and others have had multiple foreign bodies in the peanut group. Carmody had three cases of teeth in the right bronchus.

In spite of a careful search of the literature and from conversations with the leading endoscopists with various special groups, I have been unable to find a case in which teeth lodged simultaneously in the bronchus of each lung.

The case reported here is one in which a tooth lodged in the left upper bronchus and another tooth in the right middle bronchus, following tonsillectomy. It is reported here for two reasons: 1. It is unusual in that there is no other case of teeth lodging simultaneously in the bronchi of each lung; 2. to emphasize that care should be taken to guard against such a complication of tonsillectomy.

Loose teeth are rather common occurrences in patients having an operation for removal of the tonsils and adenoids, and should always be scrupulously searched for prior to the operative procedure and after its completion.

The commonest symptoms of foreign body in the lung, in the order of their occurrence, are: cough, dyspnea, pneumonia, cyanosis, pains in the chest, hemoptysis and profuse expectoration. In some instances, persistent secondary rise in temperature, which was later followed by profuse bron-

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chorrea, was the sign responsible for the diagnosis. Gill states that over one-fourth develop lung abscesses and places the morbidity at 40 per cent. Bronchoscopic treatment was by far the most successful in his estimation. Certainly, today no foreign body should go unrecognized and any suspicious case should be promptly X-rayed. Some of the foreign bodies reported were radiolucent; nevertheless, the resultant blockage of drainage with increased density in the X-ray plate readily makes the diagnosis.

The patient was a white female, age 10, who was operated on for removal of tonsils and adenoids. The operation was performed under gas-ether anesthesia with the head of the operating table lowered. The operation was performed without apparent mishap, and the patient was sent back to the ward and discharged the next morning.

My initial contact with the patient was three days postoperatively, when the Resident asked me to see the child, who had returned to the hospital. The mother stated that the patient had been having high fever and a nonproductive cough for 36 hours. She had no operative bleeding and had apparently been in good condition at the time of discharge from the hospital two days before. The bowels had moved normally each day, and except for the fever and cough the mother would not have returned to the hospital.

On admission the patient seemed to be in extremis. There was moderate dyspnea with a hacking cough and a temperature of 105°. The chest findings were reported by the pediatrician as "increased breath sounds on left side with frequent coarse and few subcrepitant rales. Fremitus slightly increased on left. No lagging. No whispered pectoriloquy. Percussion note not impaired." An X-ray was made immediately. The report was: "Radiographic and fluoroscopic examination of the chest reveals a dense, somewhat irregular foreign body on either side of the spine at the level of the disc between the sixth and seventh dorsal vertebra. The foreign body on the right is somewhat nearer the spine than that on the left. Fluoroscopy in various positions confirms the impression that these foreign bodies are lodged in the main bronchi, and they are in all probability teeth. The middle lobe on the right side shows a fairly marked consolidation, due either to pneumonia or atelectasis. A few mottled shadows in the left lobe suggest early bronchial pneumonia in this area."

The patient presented somewhat of a problem due to her poor condition, which amounted almost to a state of shock; however, it was considered that any delay in removal of the foreign bodies would constitute a greater hazard and offer no hope of a cure. With this in view, the patient was taken to the operating room and ether anesthesia administered.

The tooth in the right middle bronchus was visualized and removed very readily, requiring certainly less than a minute for its removal. The tooth in the left bronchus was not visible on ordinary bronchoscopy, and it was only on extreme abduction of the head to the right and exerting pressure upward with the tip of the bronchoscope that the tooth could be visualized at all. With the maneuvers described above, a very small basal portion of the tooth just came into view. It was impossible to apply a forceps under direct vision and a side-biting forceps could not hold the tooth as it did not extend far enough on the crown to catch. An attempt was made to insert a hook around the tooth under fluoroscopic vision. This procedure required about 20 minutes, and the patient's condition, which had been very poor at the start, was decidedly worse. As a last resort the shank of a hook was bent as much as would permit and still allow passage through the bronchoscope. This was blindly pushed into

the orifice of the upper lobe bronchus back of the tooth and rotated as much as possible. Fortunately, upon pulling out the hook, the tooth was dislodged and dropped down into the lower stem bronchus, where it was easily picked up and removed. The total operating time was 21 minutes, practically all of which was utilized in removing the tooth from the left upper bronchus.

*X-ray Report:* "Following bronchoscopy, the foreign bodies are no longer visible, but the consolidation in the middle lobe is still present. The markings elsewhere in both lungs, especially in the left upper, are somewhat increased, suggesting the possibility of infection, although no actual pneumonic consolidations are present at this time."

The patient had definite evidence of pneumonia, clinically and radiographically, in the right middle and left upper lobes before removal. The next day the patient's general condition was much improved and "a radiogram of the chest at this time again shows some changes in the right middle lobe, due either to pneumonia or to atelectasis; but in comparison with the last examination considerable improvement appears to have taken place. The remainder of the right lung and the entire left lung appear to be normally aerated and no consolidations are seen."

Two days later "X-ray examination of the chest shows no essential change since the last examination. The left lung is now considered clear, and the only changes are the triangular shadow in the mid-right lung field and some possible increase in the markings extending to the right base." Six days following this last X-ray, "re-examination of the chest shows practically normal findings at this time. The shadows previously described have completely disappeared."

Following this, recovery was uneventful, and 17 days after removal of foreign bodies patient was discharged as well.

It has now been more than six years since the operation, and the patient has developed into a normal young lady.

#### CONCLUSIONS.

1. Foreign bodies are aspirated even with patients in the Trendelenberg position, and this should always be guarded against in any operation around the oral cavity. In the present age of intratracheal anesthesia and the widespread practice of intubation by a competent anesthetist, this same possibility must be borne in mind in any case where intratracheal anesthesia is used.

2. In any case in which surgery around the oral cavity is done (and this includes intubation), X-rays of the chest for possible foreign bodies should be made if there are any symptoms present which are not fully explained as the result of this surgical procedure.

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## HEMOLYTIC STREPTOCOCCUS BACTEREMIA OF SPHENOIDITIC ORIGIN.\*

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The case to be presented has several points of interest. It illustrates the value and effectiveness of chemotherapy in preventing the serious complications arising from suppuration of the sphenoid sinus. It is significant from the standpoint of its etiology because it draws attention to the possibility of a general anesthetic activating a sinus infection.

The patient, a man aged 30 years, was a shoe salesman by occupation. His past history was negative except for a tonsillectomy and several previous infections in his left hand. Ten days prior to admission, he had an operation performed on his knee, under general anesthesia of gas, oxygen and ether. Two days later he developed a right supraorbital headache and a nasal discharge. In the course of the following week his headache increased in intensity, he vomited several times, had no appetite and lost eight pounds. Two days before admission the headache shifted to the occiput, became unbearable, and persisted day and night.

On admission to the Private Pavilion of Mt. Sinai Hospital, the patient appeared to be acutely ill, tossing about in bed and complaining of a bursting headache. His temperature was 99° F. Examination of his nose showed an intensely congested nasal mucous membrane and thick pus in the right superior meatus. General examination revealed a palpable spleen and a T-shaped healed scar on the outer aspect of his right knee-joint, and a more recent incision lateral to the outer border of the patella, which was fluctuant and contained some serum which, on culture, proved to be sterile. The hemoglobin was 103 per cent, red blood count 6,300,000, white blood count 18,500, with 74 per cent segmented polymorphonuclear leucocytes, 15 per cent nonsegmented polymorphonuclear leucocytes, 5 per cent lymphocytes and 6 per cent monocytes. He was given morphine for his pain and started on sulfanilamide, receiving 8.5 gm. the first day. On the night of his admission, he vomited several times and had a chill with a rise in temperature to 104.2° F. A blood culture was taken, which was later reported to show innumerable colonies of hemolytic streptococci in all plates. Roentgenographic examination of the sinuses showed marked clouding of both sphenoids, particularly the right, where there was also some decalcification of the bony wall. The right antrum showed evidence of thickening of the lining membrane. The remaining sinuses were not definitely abnormal.

Despite heavy sedation the intense headache was not relieved. A lumbar puncture was negative. A diagnosis of right sphenoiditis was made, and operation was advised. A right sphenoidectomy was performed under local anesthesia. The mucous membrane of the right sphenoid was gangrenous and covered with pus. This was stripped but no areas of necrosis were seen on the bony walls. The mucous membrane of the adjacent posterior ethmoidal cells was intensely inflamed. At the com-

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pletion of the operation the agonizing headache dramatically disappeared. Culture of the pus taken from the sphenoid grew hemolytic streptococci.

*Course:* The general condition improved greatly. It is of interest, at this point, to note that the patient's sensorium was so impaired that he had no recollection of having gone to the hospital, nor did he realize that he was being operated upon. The intense headache promptly subsided after operation, but he still had occasional mild, right temporal pains. He was given sulfanilamide for one week following operation, receiving 41 gm. for his total dosage. The temperature gradually dropped to 99.6° F. on the fourth day, then fluctuated around 100° and 101° until the last week of his stay in the hospital, when it dropped to normal. He was discharged 23 days after admission, doing well.

*Comment and Conclusion:* The lack of development of a complication is highly significant. A bacteremia accompanying an acute sinusitis usually indicates an intracranial complication which may be any of the following: meningitis, brain abscess, thrombosis of the larger cranial sinuses, including cavernous sinus thrombosis or osteomyelitis. The absence of any such occurrence, of course, makes it difficult to postulate which of these complications was avoided. Chemotherapy, used preoperatively, may have been the saving grace. The general circulation, bacterial emboli and local perforating vessels to the cranial sinuses and dura may have been sterilized so that dissemination was prevented before and during operation. Eradication of the necrotic focus in the sphenoid and continued use of sulfanilamide contributed to the recovery. The successful outcome of this case suggests that adequate preliminary chemotherapy, attaining early high concentration, should be used prophylactically against the ominous complications which may arise from the bacteremias of sinusal origin before nasal surgery is instituted.

Although complications of the lower respiratory tract have been undisputably attributed to general anesthetics, their rôle in the development of sinusitis has not been recognized. Because of lack of definite evidence, the etiological factors in this case can only be inferred. Nevertheless, the symptoms followed so closely upon a general anesthetic that a causal relationship may have existed. Cyclopropane and ether cause nasal irritation and hypersecretion, and may thus contribute to a flare-up of a latent infection of the sinuses, especially of



the sphenoids, because of their dependent position when the anesthetic is administered. I have seen a chronic sphenoiditis flare-up with an intracranial complication following cyclopropane anesthesia. In this case, a sphenoidectomy was performed and an empyema of the sphenoid was found at operation. In a recent monograph, Kepes cites the case of a female patient, 30 years of age, in whom fever and headache suddenly developed several days after an appendectomy. Because of severe pains in the ear, accompanied by a myringitis bullosa, attention was focused on that organ, and a mastoidectomy was done when a meningitis developed. Nothing pathological was found. The next day the patient died. At autopsy, an extensive basilar meningitis was observed, and there was also marked suppuration of the sphenoid sinus with pus and necrosis of its lateral wall. As there are no other etiological factors in my case, and the past history of sinusitis is presumably negative, it would seem conceivable that the gas, oxygen and ether anesthesia, which the patient had at the time of his knee operation, contributed to the development of the disease in the sphenoid. If the patient had a latent sphenoiditis, then possibly the anesthetic may have been responsible for an acute exacerbation.

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